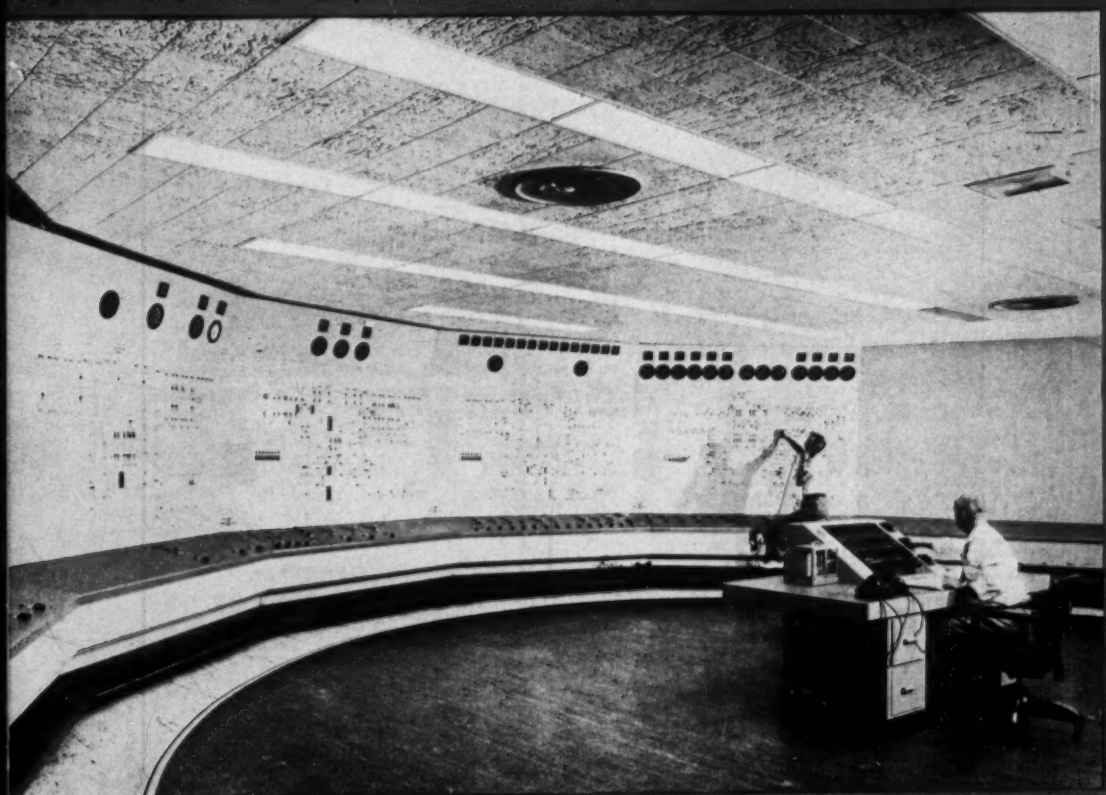
Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

APRIL ★ 1951

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

Page 133—Journal Section of the American Society of Heating and Ventilating Engineers



Conditioned air a vital "tool" in defense effort ..... *See page 90*

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"HET UP" about YOUR wasteful heating SET UP?

Why not change to

THERMOLIER

UNIT HEATERS

If you're dismayed about *last winter's* high-cost-of-heating, how about next year — when it may be as hard to get *fuel*, as it was for you to get *heat* this year?

Here's a red-hot tip. To save heat and fuel, install Thermolier Unit Heaters. But don't delay. Material shortages can seriously disrupt the production of unit heaters. In addition, skilled men are available to make installations now. They may not be in the days ahead. Study these Thermolier Unit Heater advantages — *and act promptly*.

HEATING COMFORT Thermoliers provide quick heating from a cold start. Desired room temperatures are easily maintained within a close range.

LOW FIRST COST Thermoliers are so efficient and so compact that their heating capacity is often equivalent to the capacity of cast iron radiation or pipe coils of twice the cost.

ECONOMY OF OPERATION Heat is forced down to the working level . . . not banked uselessly at the ceiling level.

ADAPTABILITY TO EQUIPMENT AND FLOOR LAYOUT Thermolier unit heating is widely used in industrial plants and warehouses, garages, stores and public buildings. The units and the simple piping are overhead where they do not interfere with arrangement of the operating machinery or equipment.

THERMOLIER CONSTRUCTION FEATURES THAT SAVE MONEY

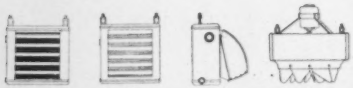
Use of plain thermostatic trap, the simplest and least expensive kind of trap, is practical because of Thermolier's exclusive internal cooling leg.

Maximum capacity provided at all times and annoying, destructive water hammer eliminated by built-in pitch of tubes and internal cooling leg which assures continuous drainage of condensate.

Damaging strains caused by expansion and contraction eliminated by "U" type expansion tubes.

Safety and durability assured with leak-proof tube-to-header construction.

Eight other important features. Write for Thermolier Catalog.



Horizontal Delivery | Textile Model | Velocity Nozzle | Vertical Delivery

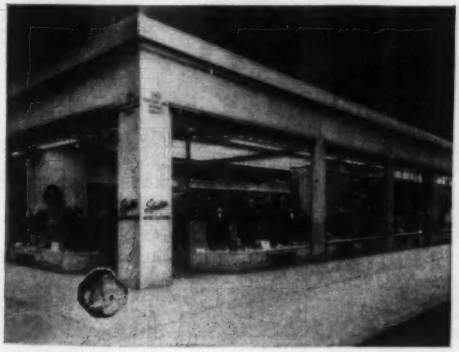
GRINNELL

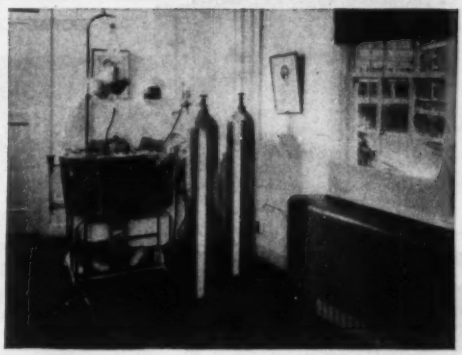
WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

Tools of Air Conditioning

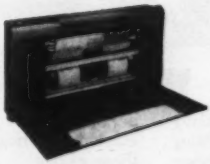
JOB IDEAS BY usAIRco





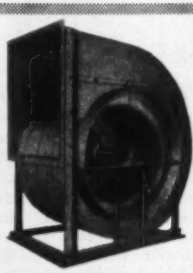
Note compactness of installation.

PROBLEM: conditioning Joseph Shulster's New York City clothing store on first floor and basement of 20-story building without wasting floor space or city water. SOLUTION: 15-ton Refrigerated Kooler-aire placed in corner of basement room. Conditioned air is distributed from this compact central plant through grilles in main selling area; ceiling diffusers in fitting rooms, office, basement. Built-in evaporative condensor cuts water consumption as much as 95%



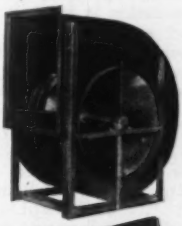
Open view of recessed models.

FLEXIBILITY UNLIMITED—a major feature of usAIRco's Modu-aire. Here it's shown in the Bremerton Naval Hospital near Seattle. Each room has an individual unit connected to central system with piping. No ducts needed, no complicated zoning. Units can be individually adjusted to meet individual room requirements. Easily installed.

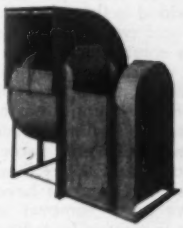


TYPE FC blower for ventilating or exhaust duty in all types of commercial and industrial buildings.

TYPE A blower generally used for higher pressures and non-overloading characteristics. Suitable for direct motor connection.



TYPE CH blower, weatherproofed housing for use indoors or outdoors. Widely installed for ventilating or exhaust in apartments, offices, public buildings, factories.



UNITED STATES AIR CONDITIONING CORP.
3300 Como Avenue S. E. • Department D
Minneapolis 14, Minnesota

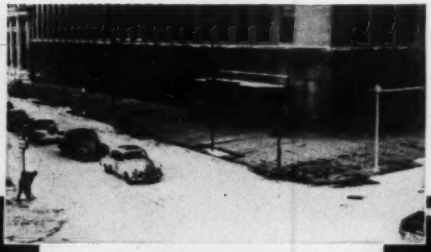
Please send your new booklet, plus literature on items checked.
____Modu-aire ____Blowers ____Refrigerated Kooler-aire

Name_____

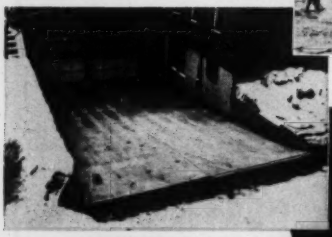
Address_____

City_____ Zone____ State_____

usAIRco
Everything In Air Conditioning



COMMERCIAL BUILDINGS

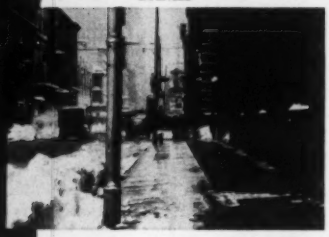


PRIVATE HOMES

CLUBS

FUNERAL HOMES

BANKS



Here's how BYERS SNOW MELTING SYSTEMS Came Through Last Winter's Toughest Tests

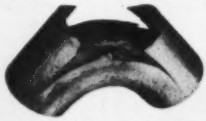
Last winter's record-breaking snowfalls gave Byers Snow Melting Systems a real workout. The above illustrations are typical of the results and suggest the wide variety of applications using this modern snow removal method. The coils of Byers Wrought Iron pipe, embedded in the sidewalk or pavement and carrying hot water-anti-freeze solution, made the heaviest snow vanish magically as it fell.

Satisfied users everywhere are constantly adding new chapters to the snow melting success-story. Householders find snow melting an economical luxury. Stores, hotels and service stations have cut excessive snow removal costs and enjoy increases in patronage. Industrial plants keep shipments moving, ban lost time at shift changes by using snow melting systems in loading platforms and access roads. This ever-increasing acceptance is explained by remarkable performance records like those above.

Byers Wrought Iron pipe is ideally suited for this service because of its combination of essential qualities. Its corrosion resistance has been repeatedly proven. Its heat emission is high. It is easily formed and welded. It expands and contracts at virtually the same rate with concrete. And it has ample mechanical strength to withstand damage during installation.

NEW BULLETIN ON SNOW MELTING. This new bulletin covers the entire field of snow melting—design, installation, operation . . . and explains why dependability demands the use of Byers Wrought Iron pipe. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.



WHY WROUGHT IRON LASTS

This notch-fracture test specimen illustrates the unusual fibrous structure of wrought iron—which is responsible for the unusual corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Heating Piping & Air Conditioning

Vol. 23, No. 4

(with which is merged the Aerologist)

DESIGN, INSTALLATION, OPERATION AND MAINTENANCE IN INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND PUBLIC BUILDINGS

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BRUNNER SINCE 1906 REFRIGERATION helps you serve better

Maybe we can help if you are having trouble finding the units you need!

With 69 different models, types and capacities of refrigeration condensing units being built on regular production schedules in the Brunner plants, you have more assurance of getting exactly what you need, and when you need it, without wasting time hunting.

What's more, we offer you the help of experienced factory field men backed by an able engineering staff who have encountered and answered just about every kind of refrigeration or air conditioning problem imaginable.

With so much to offer folks engaged in the commercial refrigeration business, it just doesn't make sense to deprive yourself of the advantages that come with recommending and installing Brunner's as a regular habit.

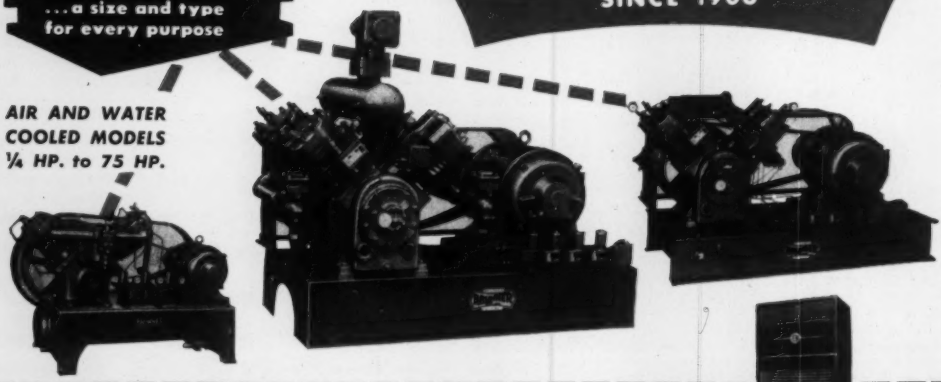
BRUNNER MANUFACTURING COMPANY, UTICA 1, N. Y., U. S. A.

P.S. *As a business man you should talk to a Brunner factory sales engineer. It costs nothing to listen, and you may discover that you have been missing a good bet. Your name and address written on the margin of this ad and mailed to us at Utica is all that is necessary.*

REFRIGERATION CONDENSING UNITS ...a size and type for every purpose

BRUNNER SINCE 1906

AIR AND WATER COOLED MODELS ¼ HP. to 75 HP.



BRUNNER SINCE 1906

AIR CONDITIONING

Self Contained Units in 4 sizes: 3-5-7½ and 10 HP.
Remote Installation Types from 3 to 75 HP.

Depend on FAR-AIR* for better air filtration...

Specify FAR-AIR Filters like this:

"Filters shall be permanent, impingement, washable, all metal, panel type. Media shall be zinc electroplated, 14 mesh steel screen, arranged in alternate layers of flat and herringbone-crimped screens, 4 layers of each per inch, rod reinforced, and enclosed in a frame of 16 ga. steel with flush mitered corners. Resistance to air flow of a clean filter shall not exceed 0.12" wg at 3.6 cfm per square inch of net face area.

"Holding frames shall be factory built of 16 ga. steel "T" section, bonderized and bake enameled, with felt air seal, interlocking edges, and filter locking device.

"Filters shall be FAR-AIR Type 44 and frames shall be FAR-AIR Standard Interlocking as manufactured by Farr Company, Los Angeles 43, California.

Your air conditioning system depends on proper air filters for its efficient operation and long service life, yet the air filters account for only a small percentage of the entire system's total cost. FAR-AIR filters cost a little more than ordinary types but they are worth far more than they cost because *they have no equal* in efficiency, dirt-holding capacity, ease of cleaning and quality of construction.

Install Far-Air Filters now and take advantage of their over-all economy while enjoying better air filtration. Write for complete information.

Users of FAR-AIR Filters include:

Carnation Co. • Eastman Kodak Co.
Westinghouse Electric Corp.
Monsanto Chemical Co.
Wm. Wrigley, Jr. Co.

*Trade Mark Reg.

FAR-AIR FILTERS

"Better by Farr"

FARR COMPANY *Manufacturing Engineers*

Los Angeles • Chicago • New York

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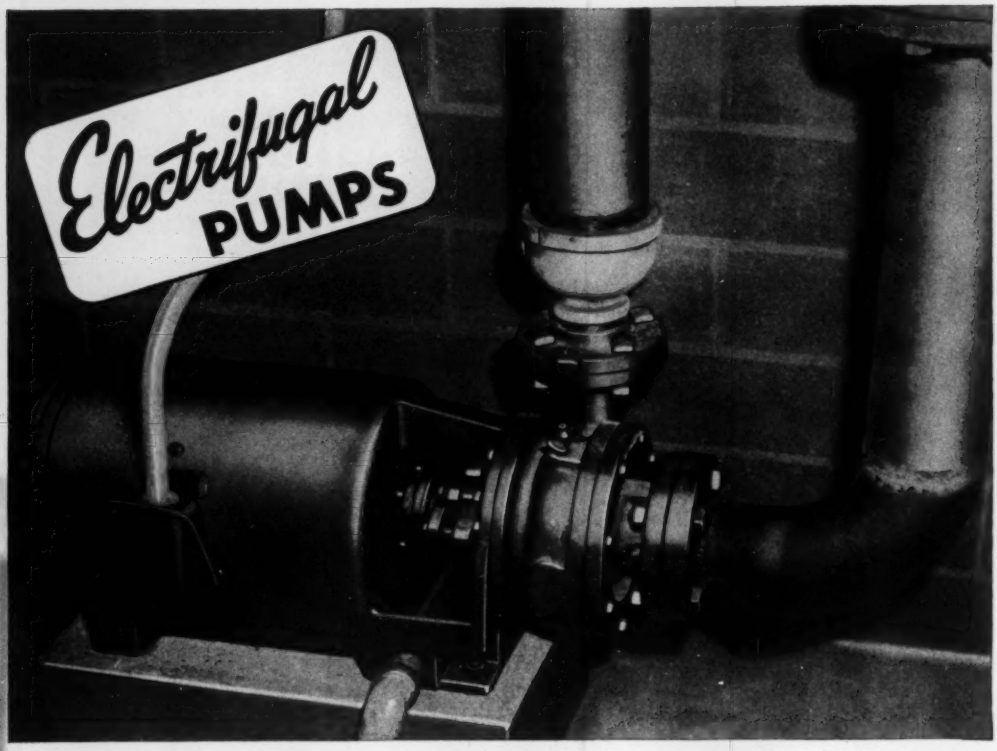


Quick, Easy Installation

SAVE INSTALLATION TIME AND COST by standardizing on Allis-Chalmers package pumps for air conditioning and heating. The complete pumping unit comes in one piece, ready to run. Simply bolt the pump to the floor, connect power and piping and you're ready to pump. No special foundation is required, no coulings or other extra parts.

Because the frame is one solid piece of rigid, corrosion resistant cast iron from motor end bell to the pump mounting flange, alignment is perfect and permanent. No alignment time is required on the job, and it is nearly impossible to disturb the alignment during installation.

Nation-wide Engineering Help and Certified Service

Every Allis-Chalmers pump representative is a competent application engineer who will help you select exactly the right pump for your application. He can save you many hours of engineering time and many dollars of engineering cost. And 94 Certified Service shops throughout the country provide factory-approved parts and repair service to your customers.

Call your Allis-Chalmers Authorized Dealer or Sales Office next time you have a pump problem. Or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletins 52B7529 and 52B6140.

A-3323

Electrifugal, Texrope and Vari-Pitch are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

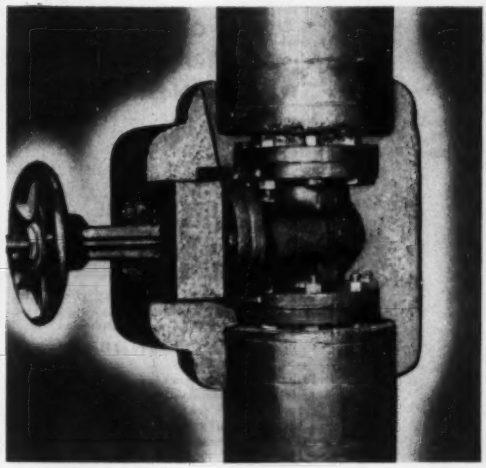
by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

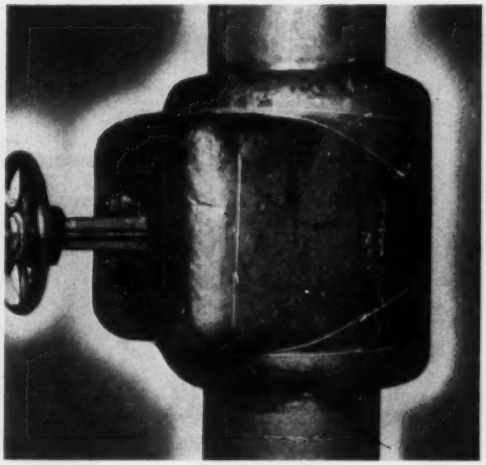
MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

ALLIS-CHALMERS





We have been asked . . .

"Several weeks ago we installed two new cold lines," writes a plant maintenance superintendent. "I noticed a considerable rise in the cost of wrap-around insulation for these lines and wondered how the cost of cork might have compared. We've avoided the use of cork cold line insulation in the past because we thought it was an expensive proposition. Were we wrong?"

In answering this question we stressed the fact that today a large part of the cost of insulating cold lines involves the time required to do the job. On this one point alone, cork turns out to be a real dollar-saver. Here's why:

Armstrong's Cork Covering is a molded covering, made to accurate dimensions to fit all sizes of pipes. That means it goes on fast. It is light in weight, structurally strong, easy to handle.

The speed with which cork goes on is particularly noticeable and advantageous when valves and other fittings are being insulated.

"Is cork covering expensive to install?"

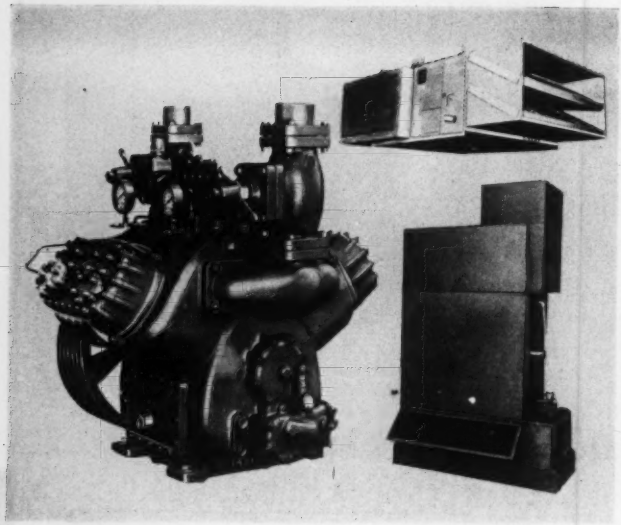
Armstrong's molded cork covers can be completely installed in less than half the time that a good wrapping job will take.

Because it saves so much time in application, the use of cork covering usually reduces the over-all cost of most cold line insulation jobs.

Cork has other features that save you money, too. It has high natural moisture resistance, which means longer service life and exceptionally low maintenance costs. Original high insulation efficiency is maintained, preventing the gradual rise in refrigeration costs that occurs when inferior pipe covering materials deteriorate and let heat through.

SEND US YOUR QUESTIONS: If you have any questions on the use of insulating materials or the construction of low-temperature facilities, please do not hesitate to write to us. We'll see that you get a practical answer. Just address a letter or post card to Armstrong Cork Company, 4404 Concord Street, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS



Who Makes a COMPLETE Freon Reciprocating System?

A completely integrated and balanced system—all *manufactured*, not just assembled, by the *one* manufacturer—that's Worthington.

No other company makes a wider variety of complete Freon reciprocating systems.

No other company offers more perfectly balanced operation of inter-related components—for lowest costs, longest life.

Worthington Freon-12 Compressors and Refrigeration Units. One basic compressor design covers a size range from 2 to 125 tons, with three cylinder sizes. Simplified construction. Lightweight automotive pistons. Worthington Feather* Valves—simplest, lightest, quietest ever made. Internal manifold. Renewable cylinder liners and leakproof, continually-cleanable force-feed lubrication in larger sizes. Positive manual or automatic capacity control. Available in self-contained compressor-condenser units.

Worthington Air-Handling Units. Perform complete air conditioning functions. Water cooling or direct expansion. Five sizes: 4 to 60 tons, 4000 to 13,500 cfm. Horizontal or vertical. Sectional design.

Worthington Evaporative Condensers. All parts exposed to moisture made of zinc-coated steel, bonderized and coated with rubber-base enamel containing special rust inhibitor. Prime surface—no fins to clog. Staggered coils permit air deflection and complete wetting. Six sizes from 2000 to 27,000 cfm.

Also: *Worthington Evaporative Coolers* in same range.

*Reg. U. S. Pat. Off.

Bulletins containing complete information are available

First Completely Air-Conditioned Apartment House in New England

Beacon Towers Apartments, Brookline, Mass. is the first building of its type in New England to be 100% air-conditioned.

E. A. Berman Company of Boston, under the direction of M. L. Cail, installed a three-zone cooling water system for the 34 apartments. Individual room units are served by a refrigeration unit consisting of a Worthington Freon-12 compressor, evaporative condenser and water chiller.

The system is designed and operated for automatic heating in winter and cooling in summer.

Experience of the owners has been that the air conditioning helped to lease the apartments for 3-year periods.

Laboratory Air Conditioning Duplicates Mill Conditions

Worthington also manufactures a complete line of *centrifugal* refrigeration.

When the W. Harrison Hightower Textile Engineering Building was built at the Georgia Institute of Technology, Atlanta, to house its textile school, Worthington refrigeration for air conditioning was installed to provide the proper temperature and relative humidity required for textile processing.

Fourteen separate rooms are individually air-conditioned, through a chilled water system, from a 150-ton Worthington centrifugal refrigeration system, electrically-driven. This machine is equipped to shut off automatically in the event of trouble anywhere in the system.

Installed by Engineering Contractors, Atlanta, Ga.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

INVESTIGATE

MORE WORTH WITH WORTHINGTON

Consult Classified Telephone Directory for nearest Worthington distributor. Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J., specialists in air conditioning and refrigeration for more than 50 years. A.1.1

MASTROL SYSTEM for Forced Hot Water Heating
MASTER CONTROL
SUB-MASTER REGULATOR
PNEUMATIC CONTROLS
No. 11 Self-Operating Regulators
PNEUMATIC CONTROLS
Thermostat
Hygrostat
Radiator Valves
Packless Valves Available
3-Way FLOWRITE Valve
FLOWRITE Diaphragm Valve
Pneumatic Switches
AIRSTREAM Thermostat
POWERSTROKE
Damper Motor
ACCRITEM REGULATOR
Compressed Air or Water Operated
FLOWRITE Valve
METAFLOW Valve
Available Packless
POWERS
TEMPERATURE and HUMIDITY CONTROL
For Heating and Air Conditioning Systems
Industrial Processes
Water Heaters • Heat Exchangers
Jacket Water Cooling
All Types of Baths
Hospital Hydrotherapy
Most of your control problems can be solved successfully with the aid of a POWERS engineer and the proper application of some of our modern products. Why not profit from our 60 years of experience? There's no obligation. Phone or write our nearest office.
Series 100 Pneumatic Indicating Regulator
Pneumatic
Right: Static Pressure Regulator
Left: Series 100 Recording Regulator
Self-Operating
Thermostatic Water Mixers
THE POWERS REGULATOR CO.
Established 1891 • Offices in Over 50 Cities • See Your Phone Book
CHICAGO 14, ILLINOIS • 2720 Greenview Avenue
NEW YORK 17, NEW YORK • 231 East 46th Street
LOS ANGELES 5, CALIF. • 1808 West 8th Street
TORONTO, ONTARIO • 195 Spadina Avenue
MEXICO, D. F. • Edificio "La National" 601

COMFORT CONTROL SYSTEM

...ONLY ONE ADJUSTMENT REQUIRED

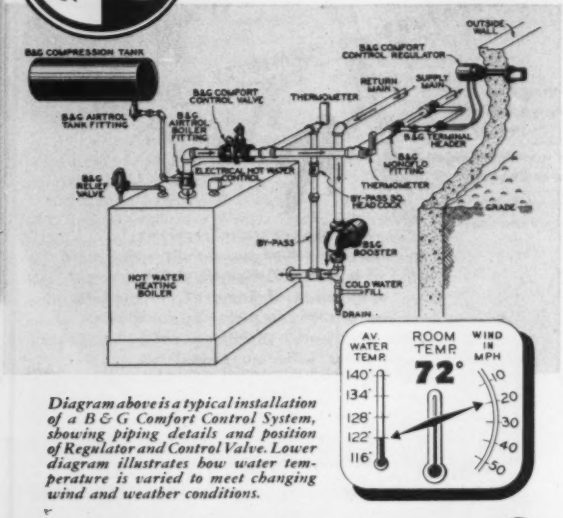


Diagram above is a typical installation of a B & G Comfort Control System, showing piping details and position of Regulator and Control Valve. Lower diagram illustrates how water temperature is varied to meet changing wind and weather conditions.

Utterly different—completely successful in maintaining uniform, comfortable temperatures in buildings heated with forced hot water, using radiant panels, radiators, convectors or baseboards. This outdoor-type control is entirely mechanical in operation—no bellows, capillary tubes or fragile electronic equipment.

The B & G Comfort Control System not only detects changes in outdoor temperature and regulates the heat supply to maintain a uniform indoor temperature, *but also provides compensation for changing wind conditions!*

An exclusive feature is the unique arrangement whereby a small amount of heat is conducted from the heating circuit through the Comfort Control Regulator to the outdoors where it is dissipated at a rate dependent upon temperature and wind velocity. This is the feature which makes the Comfort Control System truly wind-compensating.

After installing, the B & G Comfort Control System requires only one adjustment—easily made by turning a single dial.

Send for descriptive literature

All the facts on the B & G Comfort Control System are given in this bulletin, including charts showing results of temperature control with and without wind compensation.

BELL & GOSSETT Company

Dept. BZ-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd.
1400 O'Connor Road, Toronto, Canada

costly maintenance problem completely solved

with Dependable Quality

CRANE VALVES

No. 1611 Diaphragm Valve
Literature on full line on request through your Crane Branch or Crane Wholesaler

CASE HISTORY FROM CRANE FILES

PROBLEM: To find a valve that would assure longer service in a continuous batch processing operation, and reduce costs of routine piping maintenance.

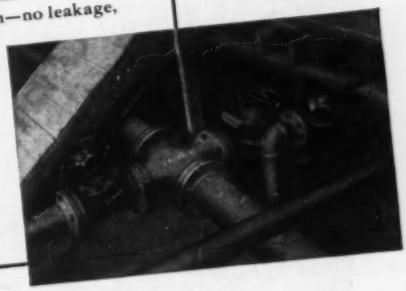
WORKING CONDITIONS: Valve to control flow of steepwater solution to steam-heated steeping tanks. Constantly exposed to weak acid vapors.

SOLUTION: Crane No. 1611 Diaphragm Valves, iron body, packless design, with separate disc and diaphragm.

RESULT: Costly problem of frequent repacking completely eliminated. Not a penny's maintenance cost—not a sign of corrosion or erosion—no leakage, or wear on internal parts—even after 4 years' service. Crane Diaphragm Valves have already given more than double the repair-free service obtained from conventional valves.

More proof of the fact that in all types of valves, Crane Quality assures the lowest cost service in the long run. That's why . . .
More CRANE VALVES are used than any other make!

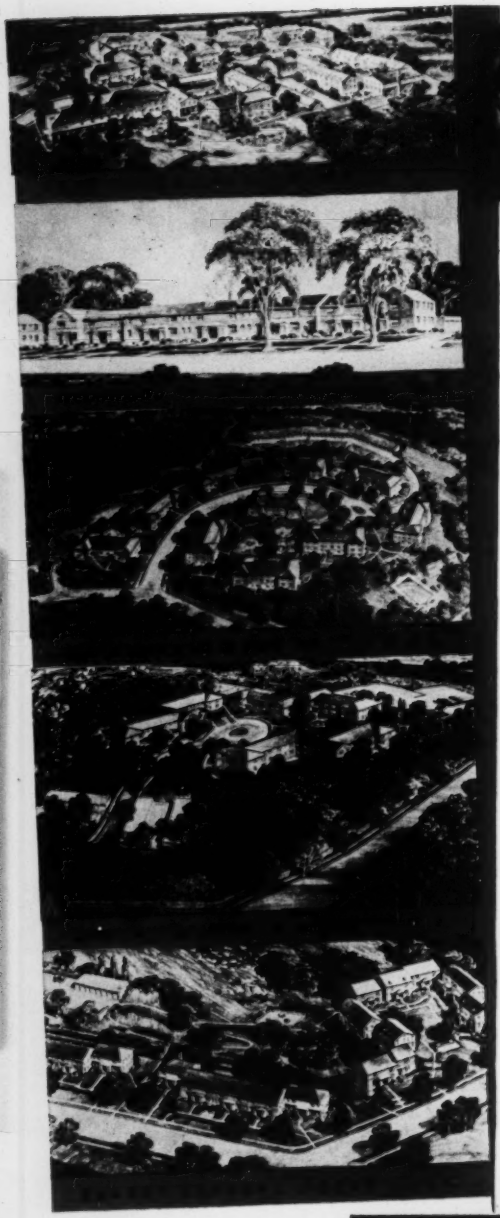
The installation—at American Maize Products Co., Hammond, Ind.



CRANE

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



architect . . Gustave W. Iser

and

engineer . . R. W. Billharz

United on Sarcotherm Modulating Heat Control

To give these outstanding apartments perfect heating comfort under all weather conditions

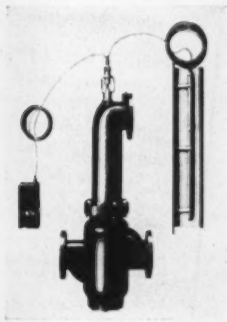
Yes, team work pays! It brings increased efficiency as well as superior design. The addition of Sarcotherm heat control to the combination made sure of owner satisfaction.

Sarcotherm is the simple, mechanical outdoor control, ideal for hot water or radiant heat.

For apartments, hospitals and institutions, it can be made fully automatic by adding the Centralized Program Panel.

Ask a Sarcotherm engineer to see you today. There is one near you. Or write for new bulletin ST-5011.

Typical centralized program panel.



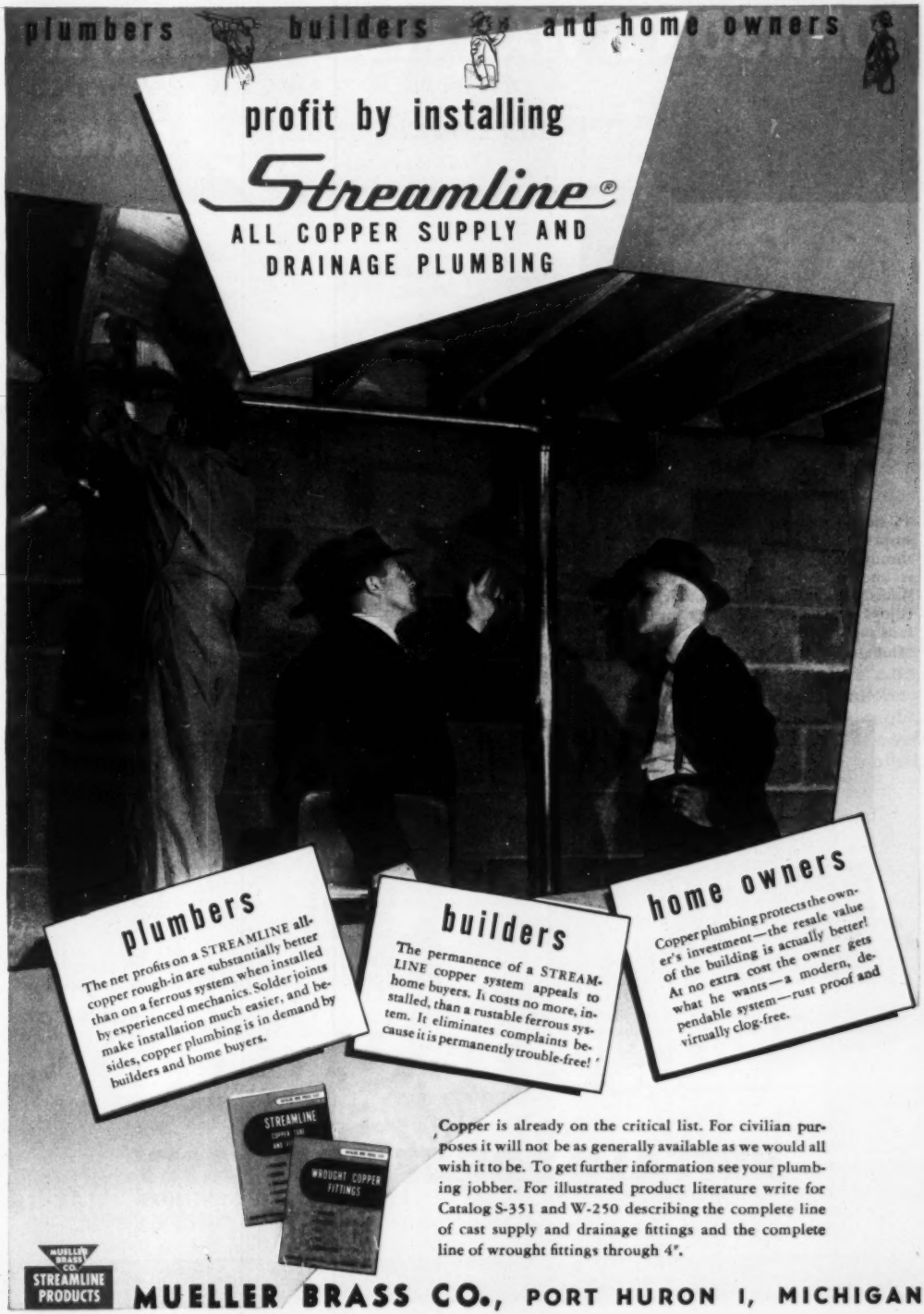
Sarcotherm weather-compensated control valve.

20

SPECIFY SARCOTHERM
SEE SWEETS CATALOG
SECTION 29E/SA

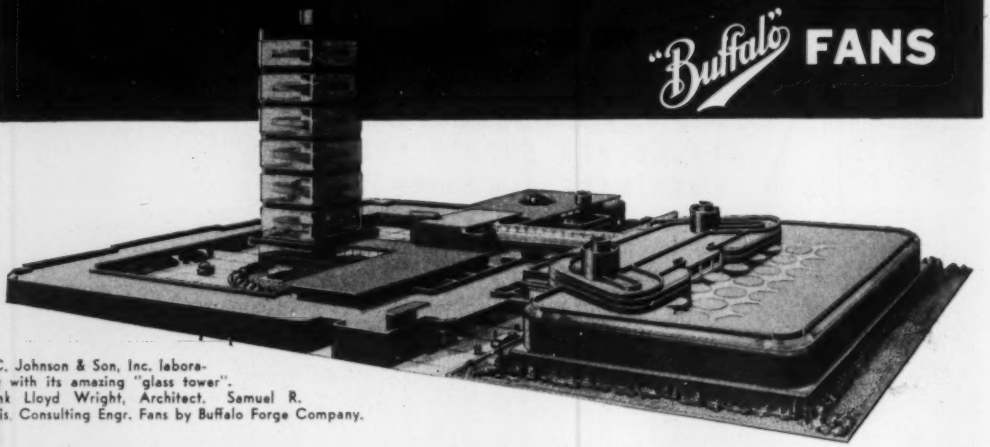
Sarcotherm

SARCOTHERM CONTROLS, INC. • Empire State Bldg. • NEW YORK 1, N. Y.


plumbers builders and home owners
profit by installing
Streamline®
ALL COPPER SUPPLY AND DRAINAGE PLUMBING
plumbers
The net profits on a STREAMLINE all-copper rough-in are substantially better than on a ferrous system when installed by experienced mechanics. Solder joints make installation much easier, and besides, copper plumbing is in demand by builders and home buyers.
builders
The permanence of a STREAMLINE copper system appeals to home buyers. It costs no more, installed, than a rustable ferrous system. It eliminates complaints because it is permanently trouble-free!
home owners
Copper plumbing protects the owner's investment—the resale value of the building is actually better! At no extra cost the owner gets what he wants—a modern, dependable system—rust proof and virtually clog-free.
STREAMLINE
WROUGHT COPPER FITTINGS
Copper is already on the critical list. For civilian purposes it will not be as generally available as we would all wish it to be. To get further information see your plumbing jobber. For illustrated product literature write for Catalog S-351 and W-250 describing the complete line of cast supply and drainage fittings and the complete line of wrought fittings through 4".
MUELLER BRASS CO. STREAMLINE PRODUCTS
MUELLER BRASS CO., PORT HURON 1, MICHIGAN

JOHNSON'S WAX RESEARCH TOWER

"Buffalo" FANS

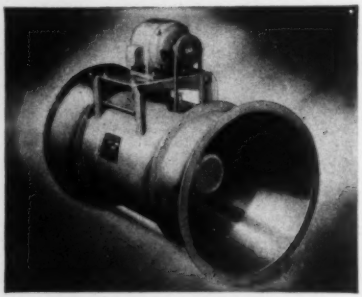


S. C. Johnson & Son, Inc. laboratory with its amazing "glass tower". Frank Lloyd Wright, Architect. Samuel R. Lewis, Consulting Engr. Fans by Buffalo Forge Company.

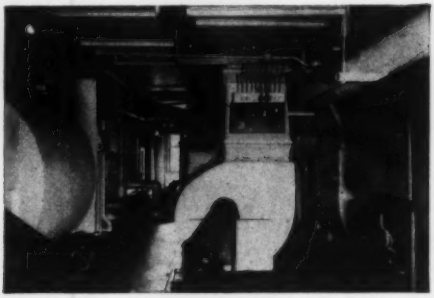
15 stories with glass and brick walls, the entire structure suspended by means of a concrete "core" running down through the center—the Johnson Wax Research Tower is one of the structural marvels of mid-century! Designed in behalf of the American Housewife, the tower enjoys conditioned, dust-free air at all times. "Buffalo" fans supply the air.

"Buffalo" Fans are putting air to good use in every type of plant—improving product and process control—promoting health and safety—stepping up worker productiveness—increasing profits. And they are doing it efficiently.

Write us about your job for air. There's a "Buffalo" Fan or Air Conditioning unit to handle it to your satisfaction!



"Buffalo" Axial Flow Fans are popular both for light-duty ventilation and air conditioning work.



"Buffalo" LL Fans are widely used to supply air for air conditioning units, like these insulated fans.

FIRST FOR FANS

BUFFALO "Buffalo" FORGE COMPANY

171 MORTIMER ST. BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Branch offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

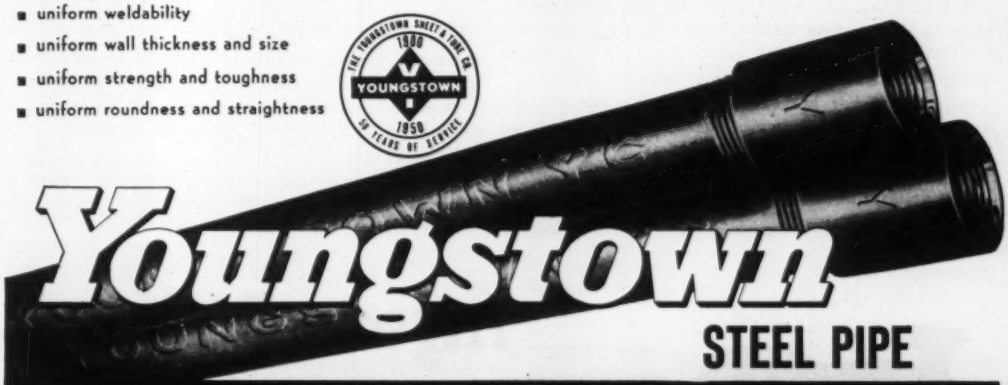
Good workmen + good tools + GOOD PIPE = GOOD JOB!

7 POINTS OF UNIFORM GOODNESS IN YOUNGSTOWN STEEL PIPE

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
- uniform roundness and straightness

EVEN the hardest jobs are easier when you work with Youngstown pipe. That's because Youngstown pipe is consistently uniform - uniform in lengths, uniformly round and straight, uniformly threaded, uniformly soft and ductile, yet uniformly tough and strong. "Youngstown" rolled into every length is the sign of GOOD PIPE.

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE



Youngstown
STEEL PIPE

THE YOUNGSTOWN SHEET AND TUBE COMPANY — General Offices — Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel — Export Office 500 Fifth Avenue, New York

PIPE AND TUBULAR PRODUCTS · WIRE · ELECTROLYTIC TIN PLATE · COKE TIN PLATE · HOT AND COLD FINISHED CARBON AND ALLOY BARS · RODS · SHEETS · PLATES · CONDUIT · RAILROAD TRACK SPIKES

They Weren't Stubborn...They Just Didn't Believe It Was Impossible

Thank goodness there are still fellows around who aren't satisfied with just "good enough"!

Most people in the air conditioning trade figured that the various types of pumps used to recirculate water in air conditioning systems were doing a good job. And when compared, pump for pump, this was true. But then some hard-to-convince engineers at I-R reasoned that if they could design a *smaller* pump that would do the same work as ordinary pumps of *higher* horsepower . . . *that* would really be something. Such a pump would save on first cost. It would have the operating economy of a *smaller* pump. Also, it would bring down installation costs, while doing a better all-around air conditioning job.

So the "unbelieving engineers" at I-R went to work. When they told us, "Here it is," the skeptics wanted proof. Then they showed us improvements in design, construction and materials. What's more, they produced a line of Ingersoll-Rand MOTORPUMPS which, size for size, proved to be *more efficient and reliable* than any other type pump on the market!

The I-R MOTORPUMP has already opened the eyes of many architects, designers, and air conditioning contractors. It's available out of warehouses across the country. And these same outlets offer service on every I-R MOTORPUMP specified or installed. Get the facts now . . . ask your nearest I-R distributor or representative about them. Meantime, write for free descriptive literature. Ingersoll-Rand Company, 11 Broadway, New York 4, New York.

Ingersoll-Rand

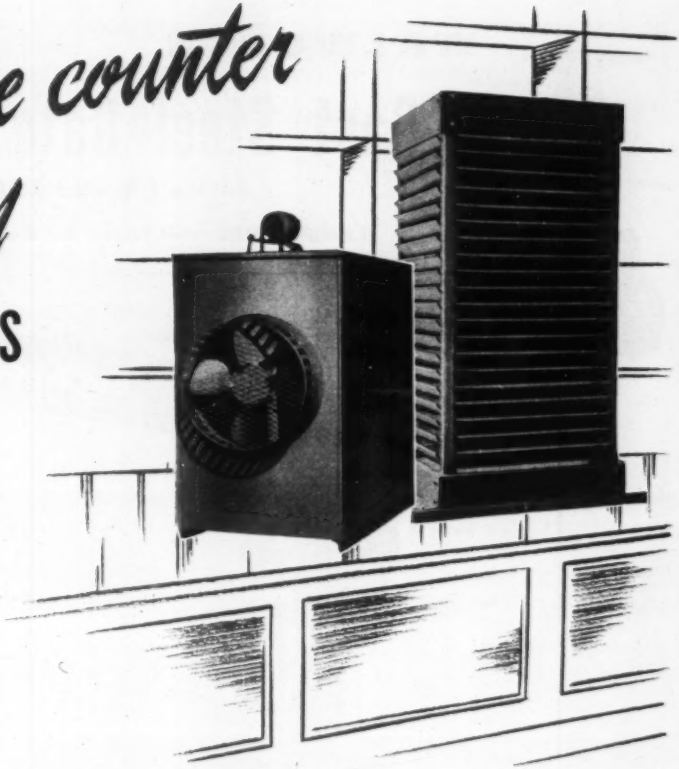
90 years of BIG PUMP know how packed into **small pumps** for air conditioning applications

MOTORPUMP

615-9

Over the counter delivery on

AQUATOWERS *and* SERIES 100 NATURAL DRAFT TOWERS



AVAILABILITY is a prime factor for consideration in most equipment today — so it is in water cooling towers for the multitude of three- to fifty-ton jobs this season.

Marley's anticipation of 1951 demand, however, precludes any compromise in quality . . . the finest towers are yours when and where you need them.

AQUATOWERS and SERIES 100 Natural Draft Towers *are ready* . . . in stock awaiting your orders. Service-proved in thousands of installations, these towers are accepted as the standard of the refrigeration and air-conditioning industries. Both types of towers are economical to install and to operate.

There's a size for every job . . . for new construction or for operating improvement of existing installations . . . for location indoors or outdoors.

For complete information contact your nearest Marley representative (one in every large city) or write for Bulletins AQ-50 and 100-51a.

Also Producers of

DRICOOLERS
VAIRFLO TOWERS
DOUBLE-FLOW TOWERS
INDUSTRIAL SPRAY NOZZLES

The Marley Company, Inc.

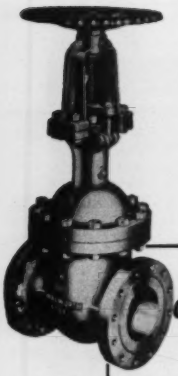
KANSAS CITY 15, KANSAS

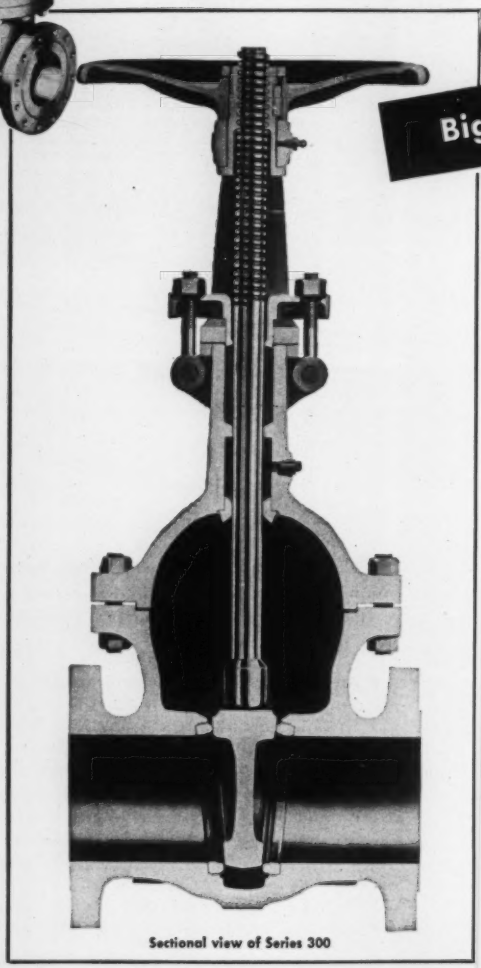
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2" to 24") insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

KENOSHA Youth foundation

720-59TH PLACE—PHONE 4104
KENOSHA, WIS.

Mr. G. A. Tiegs
Manager, Service Sales Department
Detroit Stoker Company
Monroe, Michigan

Dear Sir:

Replying to your letter of October 18, with reference to our order No. 1058, we thank you for your interest in calling our attention to your new type Hi-tuyere.

We are ordering enough supplies to put our three stokers in tip top condition and to have a few parts on hand for emergencies. Our stokers are now over 20 years old. One of these days we will probably want to replace them with more modern stokers. At that time we will be writing to you because we are 1,000% sold on Detroit Stokers from the standpoint of efficiency of operation and low maintenance cost.

Sincerely yours,

Frank A. Thompson

Frank A. Thompson, Bus. Mgr.

P. S. We want to thank you for your good service over the past twenty years, even during the war period when many firms more or less forgot their pre-war customers.

Detroit LoStoker for "firebox application". Also available for brickset boilers.

The enthusiasm expressed in this letter is typical of that of thousands of *Detroit Stoker* users.

Detroit Stokers are built better, last longer with less maintenance and save more fuel.

This installation consists of three Detroit LoStokers applied to Kewanee Boilers, placed in operation in 1930.

Detroit LoStoker, now available with *Detroit Adjustable Coal Feed* is a Compact-Single Retort-Mechanically-Driven-Plunger Feed-Side Cleaning Stoker. Coal feed and air supply may be controlled automatically as well as manually. New type Hi-Tuyeres supply more air, reduce coking tendency. Lower combustible in the ash results in higher thermal efficiency.

Write for Bulletin.

SINCE 1898

There is a Type and Size of Detroit Stoker for Every Industrial or Power Need

DETROIT STOKER COMPANY

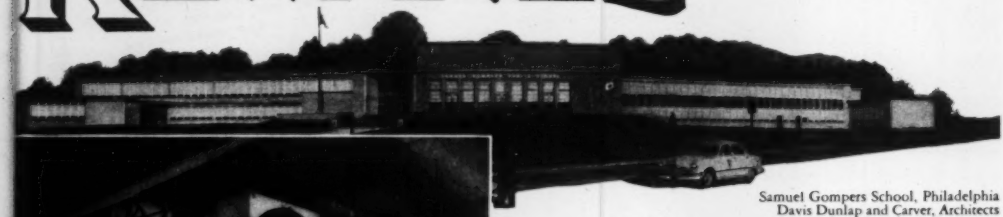
General Motors Building—Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan

For Spring Warmth IN ZERO BLASTS

Today's higher heating standards would be impossible to attain without a good boiler . . . for the *boiler is the "heart" of every heating system.* To keep pace with these stepped-up requirements an ever increasing proportion of America's schools turn to Kewanee.

KEWANEE STEEL BOILERS



Samuel Gompers School, Philadelphia
Davis Dunlap and Carver, Architects
John C. Kohler, Heating Contractor

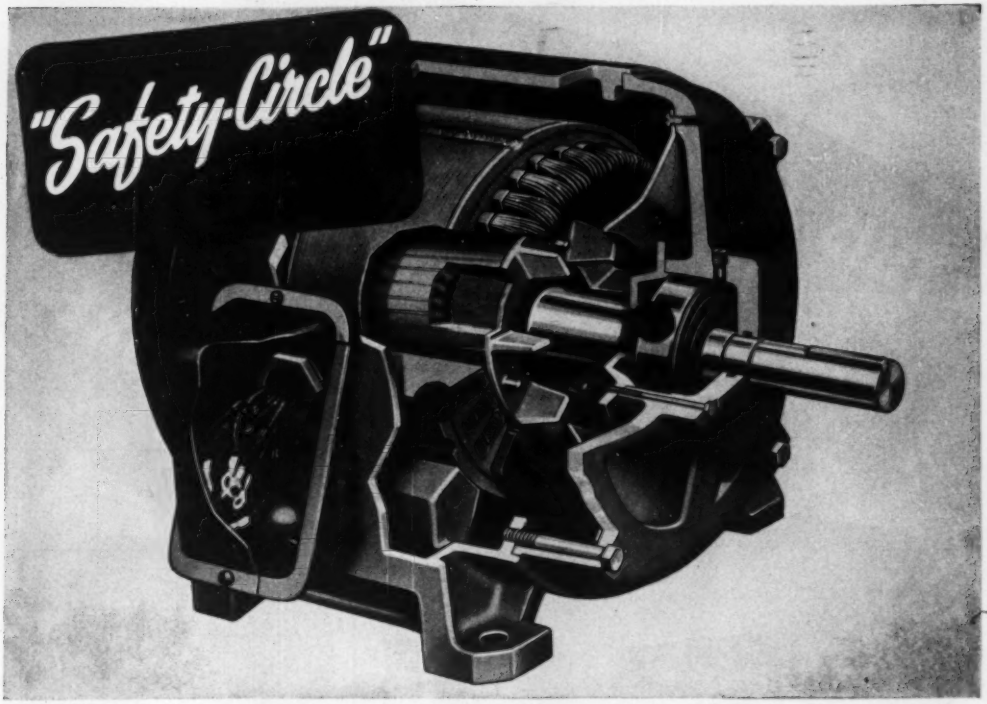
2 Kewanee Hi-Test Boilers for 125-150 lbs. pressure heat the entire Gompers School with an ample reserve for emergencies.

Whether plans call for heating with wall, floor or ceiling panels or coils, radiant baseboards or conventional radiators, *there is a Kewanee Boiler just right for the job.* And that is true regardless of the fuel used or whether mechanical or hand-firing is chosen.

Photograph shows the pair of Kewanee Boilers on the job in the Gompers School . . . assuring this modern structure a lifetime of dependable heat.

KEWANEE BOILER CORPORATION
BOILERMAKERS 80 YEARS KEWANEE, ILLINOIS
Branches in 60 Cities—Eastern District Office: 40 West 40th Street, New York City 18
Division of American Radiator & Standard Sanitary Corporation

Serving home and industry
AMERICAN STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON



Safety-Circle Motors Give You Extra Protection 3 Vital Ways

1 Protection Against Electrical Breakdown — Stator punchings of low-loss electrical steel are welded together to form a rigid base for the windings. Complete stator is multiple dipped in special insulating varnish and baked after each dip. Special cambric insulation is placed in coil ends between phases to provide further protection against electrical breakdown.

2 Protection Against Physical Damage — Cast iron frame completely enclosing working parts on all sides rigidly maintains alignment and protects motor against blows, falling objects and other physical damage. Cast iron inherently resists corrosion better than other metals used for similar purposes.

3 Protection Against High Maintenance Costs — Bearings are pre-lubricated at the factory and should need no attention for long periods. Tapped holes with pipe plugs to permit regreasing and to provide grease relief are provided.

NOW, when costs are high and skilled labor is becoming scarce, you need these extra protection features that only *Safety-Circle* Motors give. 94 Allis-Chalmers Certified Service shops throughout the country give you economical, factory approved service and genuine parts.

Call your Allis-Chalmers Authorized Dealer or Sales Office for your motor needs, or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 51B6210.

***Safety-Circle, Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks.**

ALLIS-CHALMERS

A-3340

Sold . . .
Applied . . .
Serviced . . .

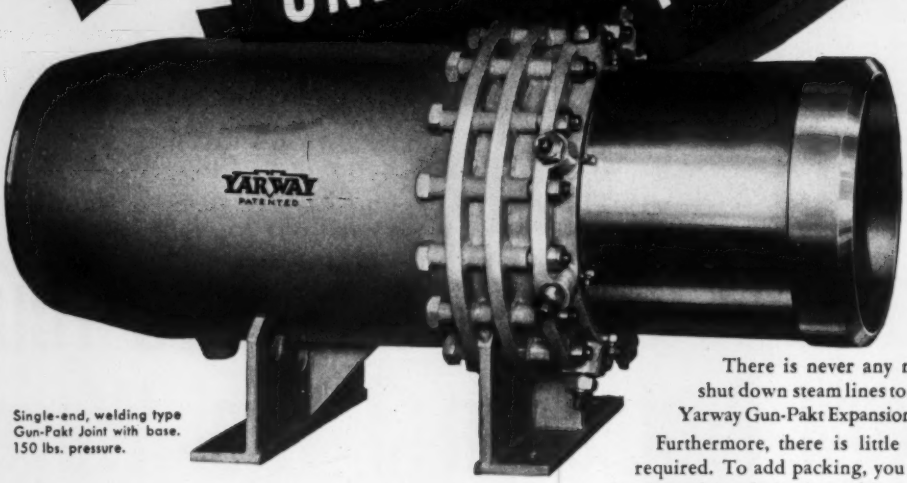
by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

THIS EXPANSION JOINT IS SERVICED UNDER FULL STEAM PRESSURE



Single-end, welding type Gun-Pakt Joint with base. 150 lbs. pressure.

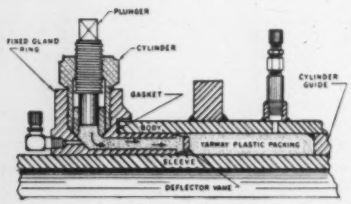
There is never any need to shut down steam lines to service Yarway Gun-Pakt Expansion Joints.

Furthermore, there is little service required. To add packing, you simply insert a plug of plastic packing, turn a wrench, and the job's done! Special Alemite fittings provide for proper lubrication.

Maintenance costs are trifling. One large user reports 65 cents per year per joint. Others claim less than that.

Gun-Pakt Joints are available with single or double-ends, welding or flanged types, in sizes from 2″ to 30″, with traverses from 4″ to 24″, and for pressures to 400 psi.

For the full Gun-Pakt story, write for Yarway Bulletin EJ-1912.



Close-up of cross-section showing detail of Gun-Pakt feature.

YARNALL-WARING COMPANY
107 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY

GUN-PAKT EXPANSION JOINT

Markings mean just what they say on WeldELLS®

A VOLUME OF USEFUL DATA ON A SINGLE SHEET—Sizes, thicknesses and dimensions of all commonly used WeldELLS and Taylor Forged Steel Flanges ingeniously condensed on a heavy durable, letter-sized card. Indispensable for piping men. Coupon brings free copy.

No other fittings for pipe welding are so true to their markings as WeldELLS — so absolutely uniform, mechanically, metallurgically, dimensionally.

It would be bad business for us to say this if thousands of users had not already said it for us and to us. "There are no bad ones" is nearly always the foremost reason given by practical men for insisting on WeldELLS.

Pick up any WeldELL and check it against the tabulation of its size, wall thickness, and other dimensions. It will be right on the head. And it will be right on the head in plus-value features, too—features that are combined in no other fittings.

Remember that the finest line of welding fittings is also the broadest line. Coupon brings your copy of useful data described below.

TF

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS

General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Please send a copy of your data sheet covering Taylor Forge Welding Fittings and Forged Steel Flanges.

NAME_____

POSITION_____

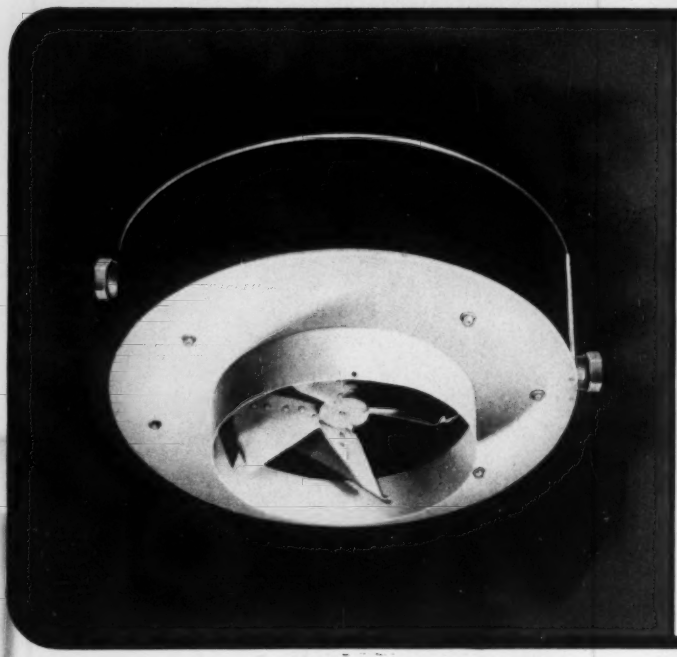
COMPANY_____

STREET ADDRESS_____

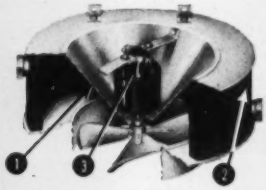
CITY_____ ZONE____ STATE_____

510-0451 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

new dunham unit heaters



dunham design features you'll want to see



1. **sturdy motor support cone** protects motor from excessive heat, dust and other impurities.

2. **improved header design** requires fewer solder joints; assures uniform steam distribution; eliminates air pockets.

3. **resilient motor mounting** insulates motor vibrations, avoids transmission of noises through piping.

throw heat where you want it
assure quieter operation
save on installation expense

You're looking at . . . and into . . . Dunham's new Vertical Discharge Unit Heater. Designed inside and out to assure continued delivery of original rated capacities, these new heaters can maintain perfect balance between air volume, velocity, and final outlet temperatures. They keep customers comfortable and contented because they:

throw heat where needed—Motor support cone effectively funnels air from heating element to propeller fan; selection of air diffusers assures proper directional control of heat throw.

assure quieter operation—Motors are rubber mounted to minimize vibration and noise. Correctly pitched fan blades operate at relatively slow speed for quiet operation.

save on installation expense—Supply and return tappings located on sides of heater for simplified horizontal piping hook-up. Fewer fittings required.

Here are the Facts

If you are engaged in defense or essential civilian production, it will be to your advantage to know more about these heaters. Bulletin 2101-2 contains complete information. Write for your free copy.

DUNHAM

C. A. DUNHAM COMPANY
400 W. Madison Street, Chicago 6, Illinois
In Canada: C. A. Dunham Co., Ltd., Toronto
In England: C. A. Dunham Co., Ltd., London

heating systems and equipment

Vari-Vac Differential Heating • Fin-Vector Radiation • Convector Radiation
Baseboard Radiation • Vacuum Pumps • Condensation Pumps • Horizontal Heaters • Cabinet Heaters • Traps • Valves

One 10 horsepower and a 25 horsepower Century motor furnish power to air condition an office.

Century 75 horsepower Type SCH motor driving a compressor in a skating rink.

Unusually Quiet Starting and Running Characteristics

For REFRIGERATION COMPRESSORS

You Need the High Starting Torque of..... *Century*

Type SCH Motors

Century Type SCH, Squirrel Cage polyphase alternating current High Torque motors are ideal for refrigeration compressor applications. They bring compressors up to speed smoothly and easily under full load.

Century Type SCH motors have the high starting torque characteristics required for Refrigeration Compressors. The low starting current is desirable for automatic across the line starting.

In addition, Century builds a complete line of electric motors in a wide range of types, in sizes from 1/6 to 400 horsepower. Specify Century motors for all your electric power requirements.

Century Service Is Near Any Century Motor Driven Equipment. Satisfactory performance of CENTURY products is assured by more than 200 CENTURY Authorized Service Stations supervised by 28 CENTURY Sales offices.

1. *Facilities for immediate exchange of most CENTURY standard ratings of standard construction are available at CENTURY Authorized Service Stations.*
2. *CENTURY Authorized Service Stations are qualified and equipped to service and repair any piece of CENTURY apparatus.*
3. *Genuine CENTURY renewal parts are available at CENTURY Service Stations, CENTURY Parts Distributors and at the factory in St. Louis.*

CENTURY ELECTRIC CO. is Celebrating Its **50th YEAR** in the Electrical Industry

CENTURY ELECTRIC COMPANY • 1806 Pine Street, St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

Century C MOTORS

702

IN THE REFRIGERATION FIELD,

the surest and safest way to prevent fittings leaks is to install W-S Double-diamond Screw End and Socket Weld Forged Steel Fittings.

Designs are carefully engineered. Basic Materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and, all are instrument inspected for perfection of threads, sockets, angles and concentricity. Investigate them today.

Write for Bulletin A3-50. For information on stainless and alloy steel fittings ask for Bulletin S-1.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

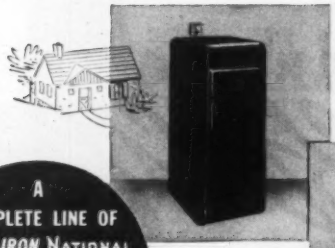
SPECIFY...

W-S

FORGED STEEL FITTINGS

DISTRIBUTORS PRODUCTS DIVISION **WATSON-STILLMAN** ESTABLISHED 1848 • ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Sheers, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

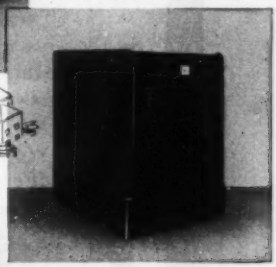


"100" series—smart and compact for small home installations in kitchens, basements or utility rooms. Wet base construction.

"200" series—sturdy, dependable heating plant for medium to larger size homes or commercial buildings with equivalent heating needs.

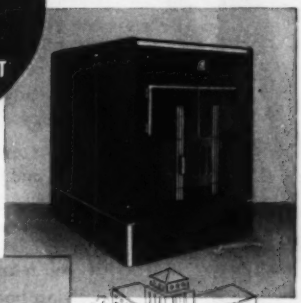
"300" series—superbly efficient plant for homes, apartments and commercial buildings where heating needs are beyond those of average size.

A COMPLETE LINE OF *CAST IRON* NATIONAL *HEAT EXTRACTORS* FOR COAL—OIL—GAS



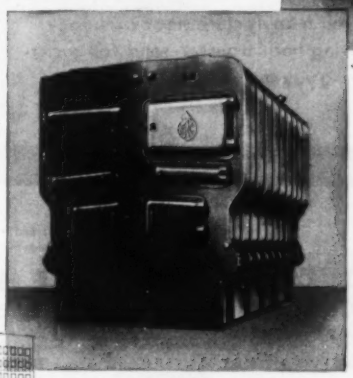
This well-known NATIONAL family of profit-producers is available for 1951 business

EASILY CONVERTED TO AUTOMATIC FIRING IF INSTALLED AS A HAND FIRED UNIT

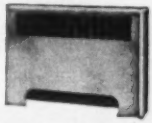


Whatever the size of the job or the requirements, there is a Cast Iron National Heat Extractor (steam or hot water) ready to fill the bill with utmost satisfaction. Over nine years of engineering research and development have provided these valued features—economical performance, long efficient life, compactness, smart appearance, easy convertibility to any fuel—which make National Heat Extractors so readily saleable and so highly acceptable to customers. Sizes range in Net I-B-R Ratings from 170 to 10,300 sq. ft. of steam and from 270 to 16,480 sq. ft. of water for hand or automatic firing. For year 'round domestic hot water, National Heat Extractors can be equipped with a tankless or storage type heater. Write for literature on National Heat Extractors, National Aero Convectors, National Art Radiators or other products of the *Complete* line of National Heating products.

"400" series—for large buildings and institutions. Big in performance, small in streamlined proportion—provides economy and efficiency in big boiler operation.



"500" series—high capacity for the largest heating jobs—schools, hospitals, apartments and hotels. "Twin Sections" for easy installation without major structural alterations.



NATIONAL AERO CONVECTORS
Constructed of enduring cast iron, they tuck away beneath windows or in convenient recesses and blanket room with a perfect balance of convected and radiant heat. Cast Iron National Art Radiators for free standing or semi-recessed installation are also famous for effective heat distribution.

THE NATIONAL RADIATOR COMPANY
JOHNSTOWN, PENNSYLVANIA

A TURN TOWARD *higher efficiency*

Wolverine Trufin*—the very versatile finned tube—offers many valuable advantages that deserve your serious consideration.

Aside from the fact that it is produced from Wolverine base tube, which is quality-controlled, Trufin

—has the fins integral with the tube itself.

—can, therefore, be bent very easily—even to small radii—without special tools.

—will withstand vibration and sudden heat changes.

—is available in a wide range of sizes, fin spacings and heights.

—is made in all copper, in all aluminum and in bi-metal (with aluminum fins and copper liner).

If you manufacture heat exchangers or any products involving heat transfer, send for our catalog sheet No. 651 giving you more technical information about this unique tube.

** Reg. U. S. Pat. Off.*

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Company, London, Ontario.

WOLVERINE TUBE DIVISION

Calumet & Hecla Consolidated Copper Company

INCORPORATED

Manufacturers of Seamless, Non-Ferrous Tubing

1419 CENTRAL AVENUE • DETROIT 9, MICHIGAN

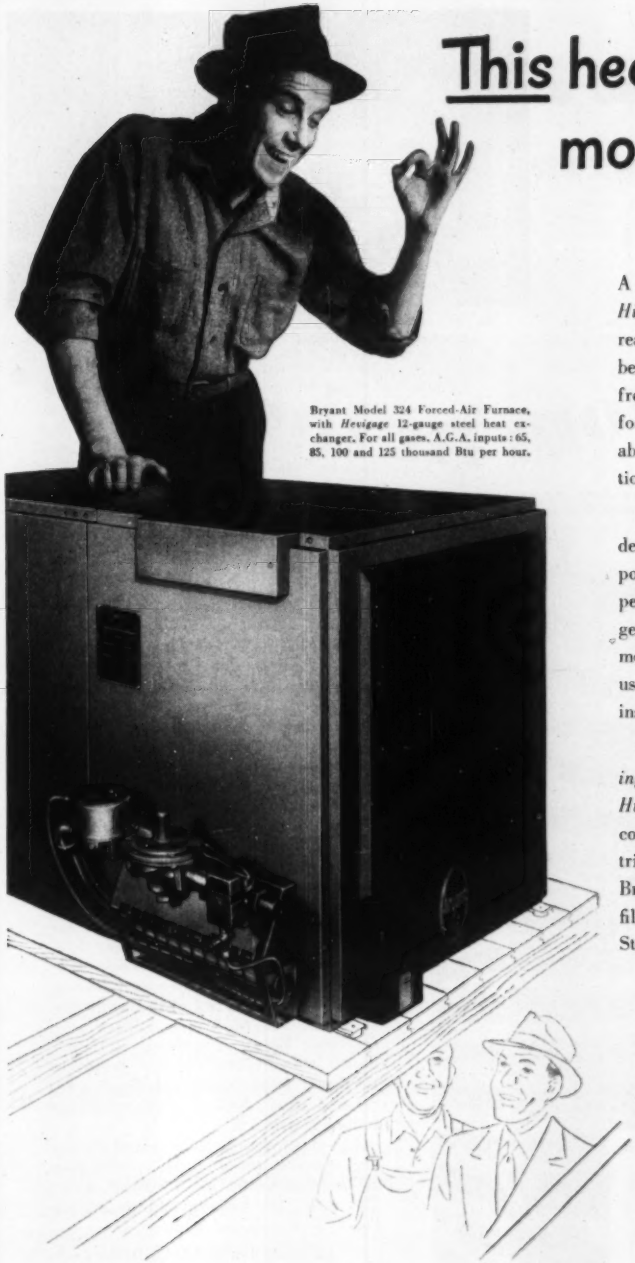
Sales offices in Principal Cities ***Plants in Detroit, Mich. and Decatur, Ala.***

Wolverine Mill Depots:

DETROIT, MICH. • DECATUR, ALA. • HOUSTON, TEXAS • LOS ANGELES, CALIF.
LONG ISLAND CITY, N. Y. • PHILADELPHIA, PA. • PROVIDENCE, R. I. • ST. LOUIS, MO.

Export Department, 13 E. 40th St., New York 16, N.Y.

This heating unit sells more *living* room



Bryant Model 324 Forced-Air Furnace, with *Hevigage* 12-gauge steel heat exchanger. For all gases. A.G.A. inputs: 65, 85, 100 and 125 thousand Btu per hour.

A truly great space saver like the Bryant *Hide-away* Gas Forced-Air Furnace adds real value and *appeal* to a house. It can be tucked away in the attic or suspended from ceiling or under the floor, releasing for storage, utility or *living* all the valuable space usually occupied by conventional heating equipment!

The *Hide-away* offers typical Bryant dependability and gas economy, with positive automatic control. Casing temperatures are *low*. Installation-wise, you get ease of handling, and structural steel mounting channels provided can also be used to suspend the unit when it is so installed.

Sell more *living* space and better *heating* at the same time with the Bryant *Hide-away* Forced-Air Furnace! For complete details, contact the Bryant Distributor nearest you or write direct. Bryant Heater Division, Dept. 153, Affiliated Gas Equipment, Inc., 17825 St. Clair Avenue, Cleveland 10, Ohio.

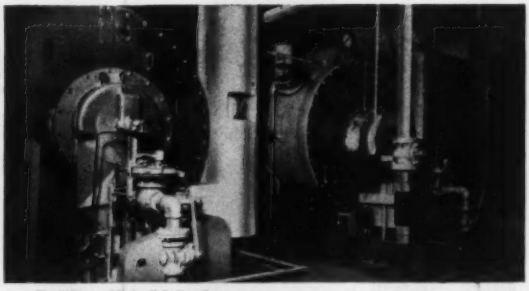
Let the pup be furnace man ... and water boy, too!

bryant

AUTOMATIC HEATING

Your *single* source of supply for everything in gas heating equipment!

"The Boiler-Room? — On the Roof, Sir"



The "First of Tulsa" Boiler Room — Two Cleaver-Brooks 200 hp. Gas Fired Boilers

Boiler-Room in the SKY..

Boiler Room Directly Behind Roof Sign

FIRST NATIONAL BANK OF TULSA
TULSA, OKLAHOMA

Carson & Lundin, *Architects*
Gaynor & Albright
Mechanical Engineers
John W. Harris & Associates
Supervisory Contractors
Manhattan Construction Co.
General Contractor
C. Wallace Plumbing Co.
Heating, Ventilating & Air Conditioning Contractor

FURTHER PROOF OF CLEAVER-BROOKS BOILER FLEXIBILITY

The new $6,000,000 First National Bank of Tulsa, one of the finest buildings in the Southwest, is heated with Cleaver-Brooks Self-Contained Steam Boilers.

For very good reasons the boiler-room was placed at roof level. (Boiler-room is directly behind roof sign at top of building, instead of conventional location in basement.) First, since it was a bank building, basement space was extremely valuable for vaults, storage, and air conditioning equipment. Then, too, with the fresh air intake on the top of the building, a considerable amount of piping was eliminated by placing the boilers at the same point. Since Cleaver-Brooks boilers require only a simple vent for carrying off combustion gases, long stack runs were eliminated, leaving additional valuable space within the building.

These are just a few of the many reasons why Cleaver-Brooks boilers were specified. Being completely self-contained and compact in design, requiring minimum head room and floor area, Cleaver-Brooks boilers presented no installation problem.

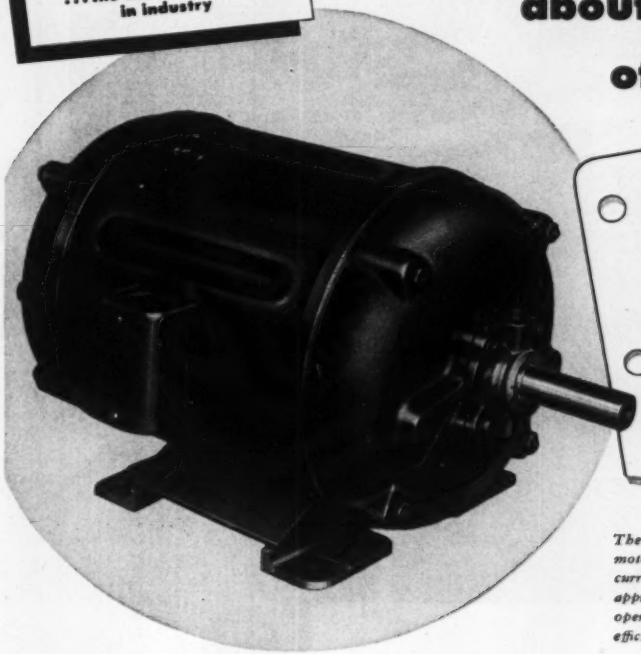
Cleaver-Brooks Self-Contained Boilers are available for oil, gas, combination oil and gas firing, 15 to 500 hp, 15 to 250 p.s.i., for heating and processing loads. Write for the catalog.

CLEAVER-BROOKS COMPANY
367 E. Keefe Avenue • Milwaukee 12, Wis.

Cleaver-Brooks
STEAM BOILERS
The First and Finest of their Class

Wagner
ELECTRIC MOTORS
...the choice of leaders in industry

it *pays* to be particular about your choice of motors...



the Wagner type **RA** *Motor offers the most simplified design to provide Repulsion-start... Induction Run*

The Wagner Type RA Motor starts as a repulsion motor with high torque but with extremely low starting current and switches to an induction motor while approaching rated speed to assure a constant high operating speed, even under overload, and a flat efficiency curve over a wide operating range.

The Wagner repulsion-start induction motor is truly industry's general purpose single-phase motor, for both fractional horsepower and integral horsepower applications. It is especially suitable for driving machines having high inertia or excessive friction at starting because of its ability to start heavy loads with low starting current. This feature is most important in the larger factional and in integral horsepower ratings.

This versatile motor is economical to maintain, requires only minimum servicing, is free from vibration and noise, and gives years of reliable service.

Build good will for your product by standardizing on Wagner Motors. There's a motor to fit your *exact* needs in Wagner's complete line. Bulletin MU-185 gives full information.

Wagner Electric Corporation
1891 WE 1951

WAGNER ELECTRIC CORPORATION
6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

MU-4

today's best buy is better air!

AAF Electro-Matic Air Filter, Kaufmann's Dept. Store, Pittsburgh, Pa.
Air Conditioning Contractors: Carrier Corp.

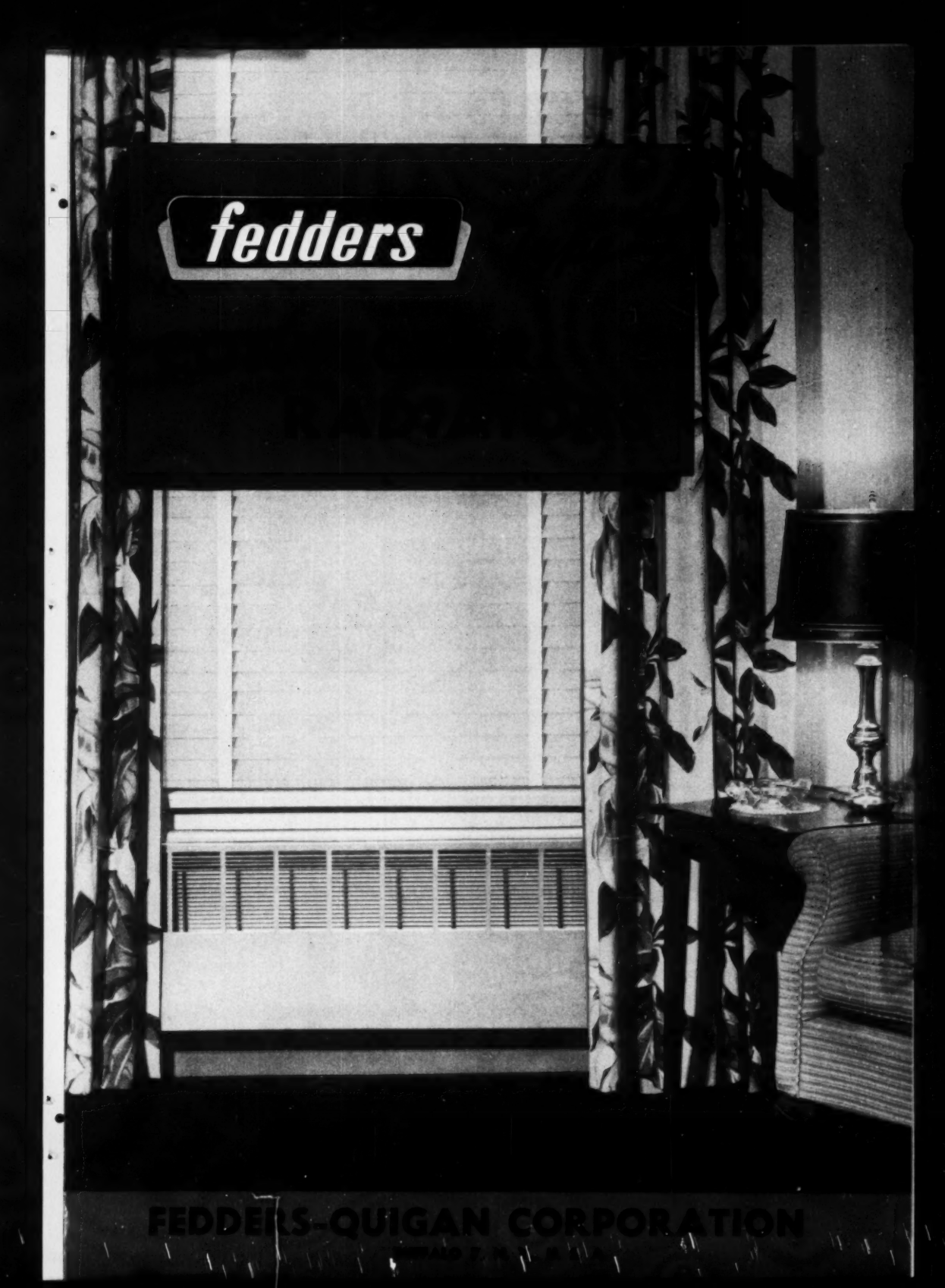
Electro-MATIC super-clean air
PAYS A PROFIT!

THE AAF Electronic precipitators shown above are part of Kaufmann Department Store's extensive modernization program. Super-clean air as part of the complete air conditioning system installed in this nationally famous store will save thousands of dollars annually in merchandise and will promote sales. AAF's Electro-Matic was specified because of its outstanding performance record in other famous stores such as Best & Co., N. Y., Carson Pirie Scott, Chicago, Foley Bros., Houston, Halle Bros., Cleveland . . . and many others. Developed exclusively by AAF engineers, the Electro-Matic is the *only* automatic, self-cleaning, electronic precipitator. Widely used in the textile, steel and other industries as well as commercially, the Electro-Matic maintains high efficiency filtration of fractional micron particles such as smoke and fumes, in addition to coarse material. The filters are standardized, self-contained units easily installed in various arrangements to meet any air volume requirement.

Exclusive features of the Electro-Matic are its automatic operation and self-cleaning function. This combination reduces servicing to routine maintenance and insures maximum operating efficiency at all times.

AAF makes the *only* complete line of air filters and electronic precipitators. If you have a problem requiring super-clean air see your nearby AAF representative or write today for our Electro-Matic Engineering Bulletin No. 250-E.

AAF **American Air Filter**
COMPANY, INC.
373 Central Ave., Louisville 8, Kentucky • In Canada: Darling Bros., Ltd., Montreal, P. Q.

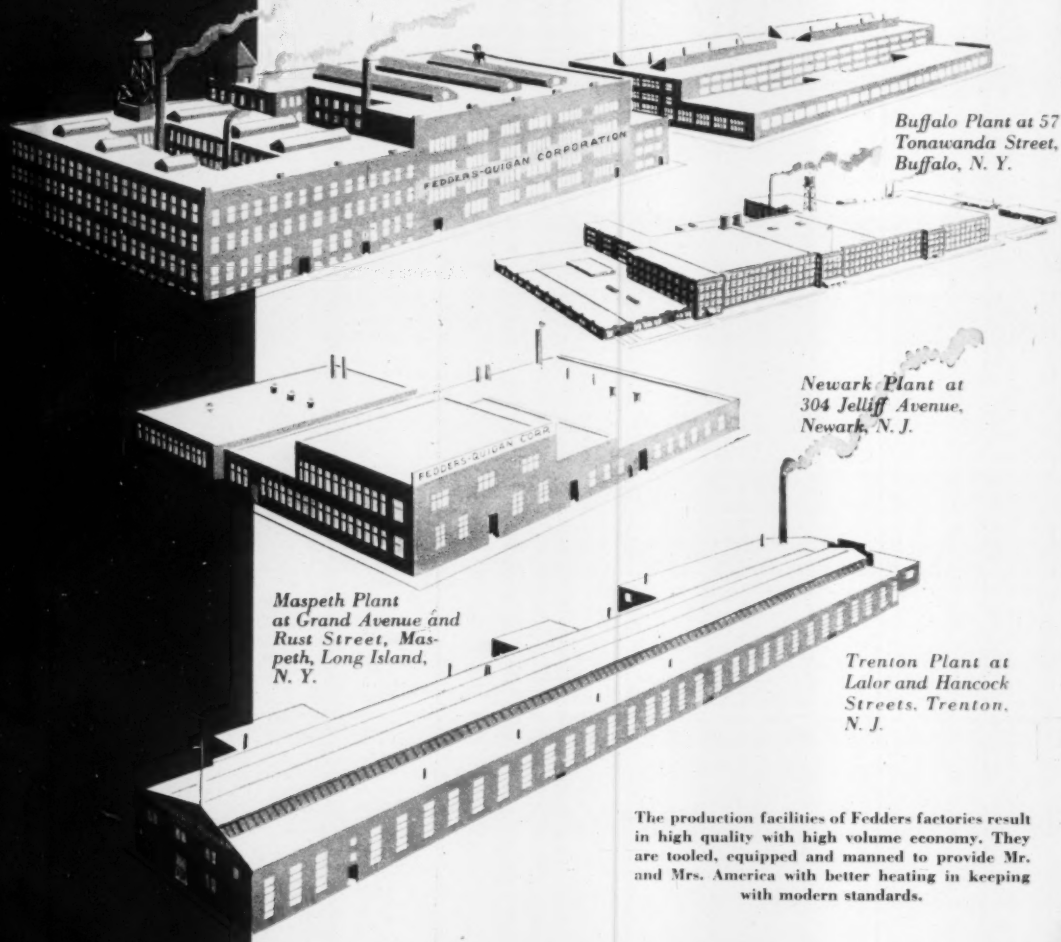

fedders
FEDDERS-QUIGAN CORPORATION

Over 50 Years of Heat Transfer Experience

behind fedders Type F CONVECTOR - RADIATORS

Working miracles with heat has been the business of Fedders engineers since 1896. Likewise, the talent, skill and experience of Fedders craftsmen have been responsible for heat transfer products which have earned a reputation for giving service, not requiring it.

The performance of Fedders Convector-Radiators assures comfort, health and fuel economy for their users.



Buffalo Plant at 57 Tonawanda Street, Buffalo, N. Y.

Newark Plant at 304 Jelliff Avenue, Newark, N. J.

Maspeth Plant at Grand Avenue and Rust Street, Maspeth, Long Island, N. Y.

Trenton Plant at Lalor and Hancock Streets, Trenton, N. J.

The production facilities of Fedders factories result in high quality with high volume economy. They are tooled, equipped and manned to provide Mr. and Mrs. America with better heating in keeping with modern standards.

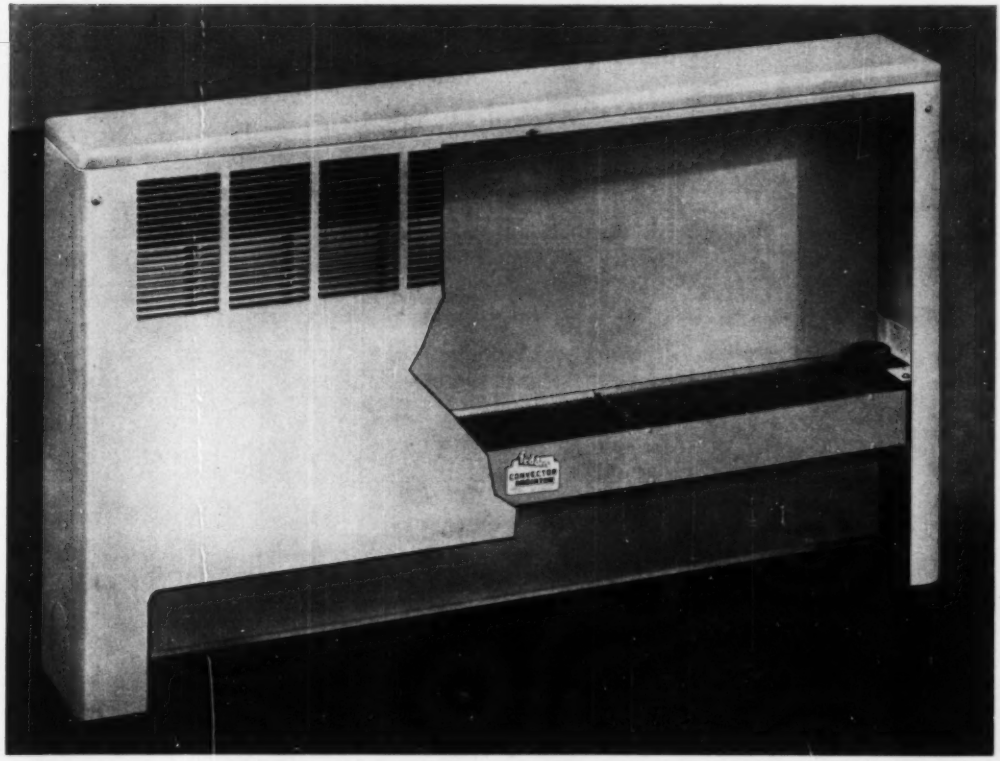
FEDDERS-QUIGAN CORPORATION, BUFFALO 7, N. Y.

● **FEDDERS TYPE F CONVECTOR-RADIATORS** are easily installed in living rooms, bedrooms, offices and institutions and other locations. They can be used with steam, and forced or gravity hot water systems. The cabinet can be used as a free-standing unit or partially recessed into the wall. Naturally induced circulation of air entering through archway at bottom and actively flowing out through louvered grille at top assures more uniform temperatures and maximum comfort at all levels.

BUILT FOR MEN WHO KNOW THEIR HEATING

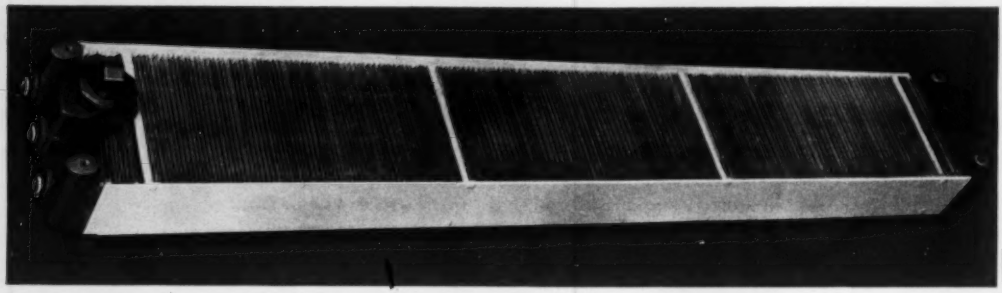
1. Handsome styling, at home in *any* surroundings.
2. Rounded edges and corners contribute to appearance.
3. Directional louvers in front panel direct the heated air actively into the room, assuring more uniform temperatures from floor to ceiling.
4. Cabinet finished in an oven baked ground coat which does not affect (shade out) delicate pastel tints when finished after installation.
5. Front panel easily removed for piping, inspection or cleaning.
6. Closed ends and front panel conceal piping.
7. Lower opening is amply high for convenient cleaning of floor and rug.
8. Light weight, easily handled and completely packaged for simplified stocking, delivery and handling on the job. Package is labeled for easy identification for size.
9. Heating element with copper tubes and aluminum fins assures prompt response to thermostatic control.

fedders



FEDDERS-QUIGAN CORPORATION, BUFFALO 7, N. Y.

fedders *Type F* CONVECTOR-RADIATORS



HEATING ELEMENT DESIGN

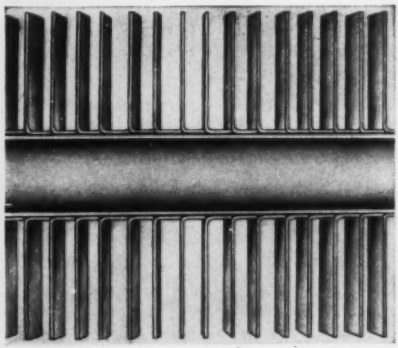
Fedders Type F heating elements have copper tubes and aluminum fins assuring prompt response to thermostatic control. Fin holes have die-formed collars which give large heat transfer contact between tube and fin as contrasted to line contact where fin holes are simply punched. Fins are mechanically bonded to tubes for efficient life-long metal-to-metal contact.

Tubes are expanded into headers with heavy ferrules power-driven into tubes.

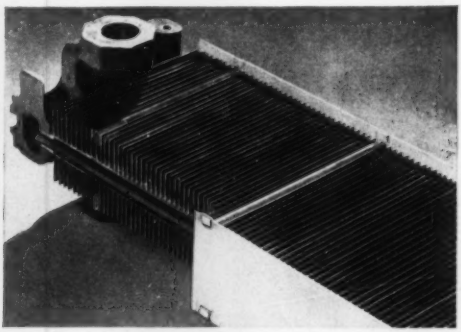
Cast headers are arranged for convenient piping connections at either end, top or bottom.

Side plates protect fins from damage. High temperature lining prevents rattles and squeaks. Adjustable screws provide proper pitch of element to suit installation conditions.

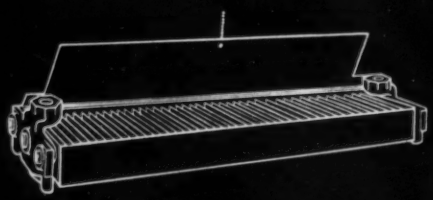
Fedders Type F heating elements can be purchased without convector cabinet for use where specially designed concealed radiation is specified as part of the building.

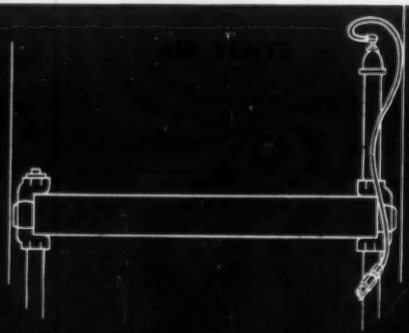


Cross section of fins and tubes. Note collars on fin holes.

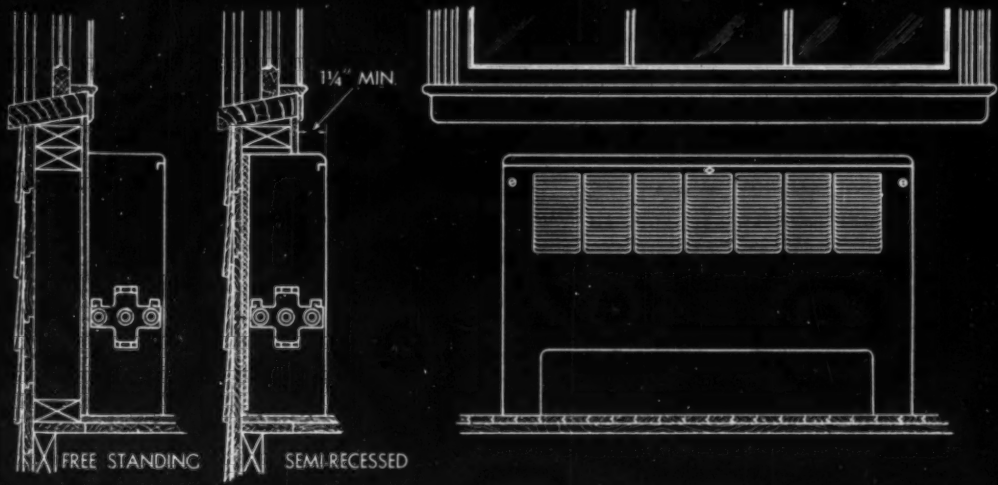


Cutaway view showing header, tube, fin and side plate arrangement.





FEDDERS-QUIGAN CORPORATION, BUFFALO 7, N. Y.



fedders

FOR EITHER FREE STANDING OR SEMI-RECESSED INSTALLATIONS

Using The Same Cabinet

Free standing installations are widely used in existing buildings and where it is impractical to cut recess into brick or concrete walls. Also they are used when replacing other types of radiation where piping is already in place.

Semi-recessed installations are ideal for new construction and remodelling jobs both in household and commercial buildings. Front panel is designed so that only 1¼" need project from wall.

HINTS ON LOCATING FEDDERS TYPE F CONVECTOR-RADIATORS

Fedders Convector-Radiators are readily adaptable to various conditions based upon size of room, location of windows, weather exposure and decorative requirements.

It is accepted practice to place Convector-Radiators under windows to offset heat loss and prevent cold spots at this point. Likewise, discoloration of walls is prevented.

Where there are several windows in the room, it is advisable to place Convector-Radiators under the window with the most severe exposure based on prevailing winds, — usually northern or western. Where windows extend too far down to the floor level, the Convector-Radiators can be placed along side or at points next to outside walls parallel to or at right angles to the windows. This will take advantage of natural convection and at the same time, cold air at the floor level will be quickly drawn into the Convector-Radiator.

FLOOR PLAN OF ROOM

When unusually long, narrow rooms are encountered, the Convector-Radiators should be located in such a manner that even heat distribution is secured in all parts of the room. It is often advisable to use two Convector-Radiators of small or medium size rather than one large unit to assure uniform temperatures.

CONFORM TO DECORATIVE REQUIREMENTS

Fedders Convector-Radiators are easily recessed into the walls. This makes them inconspicuous and eliminates interference with floor coverings and furniture arrangements. They can be finished in accordance with the decorative scheme of the room.

FEDDERS-QUIGAN CORPORATION, BUFFALO 7, N. Y.

CAPACITIES of fedders

STEAM EDR

Square Ft. EDR - 215° Steam, 65° Entering Air

Depth	Length	HEIGHT		
		20"	24"	32"
6"	20"	16.2	18.7	20.2
	24"	19.7	22.7	24.2
	28"	23.2	26.8	28.8
	32"	26.8	30.8	33.3
	36"	30.3	34.8	37.9
	40"	33.7	38.9	42.4
	44"	37.4	43.0	46.5
	48"	41.0	47.0	51.5
	56"	48.0	55.5	60.0
	64"	55.0	63.6	70.1
8"	32"	35.9	38.9	41.4
	36"	41.0	44.4	47.0
	40"	46.0	49.5	52.5
	48"	55.5	59.6	63.6
	56"	65.1	70.2	74.7
	64"	74.7	80.8	85.8
10"	36"	45.5	51.5	56.0
	40"	50.5	57.6	62.6
	48"	61.1	69.7	75.6
	56"	71.7	81.8	88.9
	64"	82.3	93.4	102.0

HOT WATER

20" HEIGHT									
Average Water Temperature									
215	210	205	200	195	190	185	180	175
3.7	3.5	3.3	3.1	2.9	2.8	2.6	2.5	2.3
4.5	4.2	4.0	3.8	3.6	3.4	3.2	3.0	2.8
5.3	5.0	4.7	4.5	4.2	4.0	3.8	3.5	3.3
6.1	5.8	5.5	5.2	4.8	4.6	4.3	4.1	3.8
6.9	6.5	6.2	5.9	5.5	5.3	4.9	4.6	4.3
7.7	7.2	6.9	6.5	6.1	5.9	5.5	5.1	4.8
8.5	8.0	7.6	7.2	6.8	6.5	6.1	5.7	5.3
9.3	8.8	8.4	8.0	7.4	7.1	6.6	6.2	5.8
10.9	10.3	9.8	9.3	8.7	8.3	7.8	7.3	6.9
12.5	11.8	11.2	10.7	10.0	9.6	8.9	8.4	7.8
8.1	7.7	7.4	7.0	6.5	6.2	5.8	5.5	5.1
9.3	8.8	8.4	7.9	7.4	7.1	6.6	6.2	5.8
10.4	9.9	9.4	8.9	8.3	8.0	7.5	7.0	6.6
12.6	11.9	11.4	10.8	10.1	9.7	9.0	8.5	7.9
14.8	14.0	13.3	12.6	11.8	11.3	10.6	9.9	9.3
16.9	16.0	15.3	14.5	13.5	13.0	12.1	11.4	10.7
10.3	9.8	9.3	8.8	8.2	7.9	7.4	6.9	6.5
11.4	10.9	10.3	9.8	9.1	8.8	8.2	7.7	7.2
13.8	13.1	12.5	11.9	11.0	10.6	9.9	9.3	8.7
16.3	15.4	14.7	13.9	13.0	12.5	11.6	10.9	10.3
18.3	17.7	16.8	16.0	14.9	14.3	13.3	12.5	11.8

fedders HOT WATER --- STEAM FACTORS

TYPE SYSTEM	Average Water Temperature in Convector-Radiator									
	215	210	205	200	195	190	185	180	175	170
Forced	227	217	207	196	185	175	163	153	142	134
Gravity	182	174	166	157	148	140	131	123	114	107

TO SELECT CORRECT SIZE OF CONVECTOR-RADIATOR FOR USE ON HOT WATER:

1. Obtain correct hot water-steam factor from above table.
2. Divide heat loss (B.T.U.) of each room by this factor to obtain square feet of steam rating.
3. Select convector-radiator size for each room from steam capacity table.

EXAMPLE: The Heat loss of a room has been estimated to be 5,500 B.T.U. One standard 40" window is in the room with the sill 25" from the floor. The forced hot water system will have an average temperature in the convector-radiator of 175°. What size convector-radiator should be selected?

1. The correct factor for a forced hot water system with an average temperature of 175° is 142.
2. A sq. ft. steam rating of 38.7 is obtained by dividing the heat loss of 5,500 B.T.U. by the factor 142.
3. A convector-radiator 6" deep, 40" long and 24" high has a rating of 38.9 sq. ft. as indicated in the steam capacity table above. This convector-radiator is correctly sized for the estimated heat loss and will fit under the 40" wide window with the sill 25" from the floor.

FEDDERS-QUIGAN CORPORATION, BUFFALO 7, N. Y.

Type F CONVECTOR-RADIATORS

RATINGS *in* THOUSANDS *of* B.T.U. *per hour* (MBh)

24" HEIGHT — Average Water Temperature								
215	210	205	200	195	190	185	180	175
4.2	4.0	3.8	3.6	3.4	3.3	3.0	2.9	2.7
5.1	4.9	4.6	4.4	4.1	3.9	3.7	3.5	3.2
6.1	5.7	5.5	5.2	4.9	4.7	4.3	4.1	3.8
7.0	6.6	6.3	6.0	5.6	5.4	5.0	4.7	4.4
7.9	7.5	7.1	6.7	6.3	6.1	5.6	5.3	5.0
8.8	8.4	7.9	7.5	7.0	6.8	6.3	5.9	5.5
9.7	9.2	8.8	8.4	7.8	7.5	7.0	6.6	6.2
10.6	10.1	9.6	9.1	8.5	8.2	7.6	7.2	6.7
12.6	12.0	11.3	10.8	10.0	9.7	9.0	8.5	7.9
14.4	13.7	13.0	12.3	11.5	11.1	10.3	9.7	9.1
8.8	8.4	8.0	7.5	7.0	6.8	6.3	5.9	5.5
10.1	9.6	9.1	8.6	8.1	7.7	7.2	6.8	6.3
11.2	10.7	10.1	9.6	9.0	8.6	8.0	7.5	7.1
13.5	12.8	12.2	11.5	10.8	10.4	9.7	9.1	8.5
15.9	15.1	14.4	13.6	12.7	12.2	11.4	10.7	10.1
18.3	17.4	16.5	15.6	14.6	14.0	13.1	12.3	10.5
11.7	11.1	10.6	10.0	9.3	9.0	8.4	7.8	7.4
13.1	12.4	11.8	11.2	10.4	10.0	9.3	8.8	8.2
15.8	15.0	14.2	13.5	12.6	12.1	11.3	10.6	9.9
18.5	17.6	16.7	15.8	14.8	14.2	13.2	12.5	11.7
21.2	20.1	19.1	18.1	16.9	16.2	15.1	14.3	13.3

32" HEIGHT — Average Water Temperature								
215	210	205	200	195	190	185	180	175
4.6	4.3	4.1	3.9	3.7	3.5	3.3	3.1	2.9
5.5	5.2	4.9	4.7	4.4	4.2	3.9	3.7	3.5
6.5	6.2	5.9	5.6	5.2	5.0	4.7	4.4	4.1
7.5	7.2	6.8	6.5	6.0	5.8	5.4	5.1	4.8
8.6	8.1	7.7	7.4	6.9	6.6	6.1	5.8	5.4
9.6	9.1	8.6	8.2	7.7	7.4	6.9	6.5	6.1
10.5	10.0	9.5	9.0	8.4	8.1	7.5	7.1	6.7
11.7	11.1	10.5	10.0	9.3	9.0	8.3	7.9	7.4
13.6	12.9	12.3	11.6	10.9	10.4	9.7	9.1	8.6
15.9	15.1	14.3	13.6	12.7	12.2	11.4	10.7	10.0
9.4	8.9	8.5	8.1	7.5	7.2	6.7	6.3	5.9
10.7	10.1	9.6	9.1	8.5	8.2	7.6	7.2	6.7
11.9	11.3	10.7	10.2	9.5	9.1	8.5	8.0	7.5
14.4	13.7	13.0	12.4	11.5	11.1	10.3	9.7	9.1
17.0	16.1	15.3	14.5	13.5	13.0	12.1	11.4	10.7
19.4	18.5	17.6	16.7	15.5	15.1	13.9	13.1	12.3
12.7	12.1	11.5	10.9	10.2	9.7	9.1	8.5	8.0
14.2	13.5	12.8	12.2	11.4	10.9	10.2	9.5	9.0
17.2	16.3	15.5	14.7	13.7	13.2	12.3	11.5	10.8
20.4	19.1	18.2	17.3	16.1	15.4	14.4	13.5	12.7
23.1	22.0	21.0	19.8	18.5	17.8	16.5	15.5	14.6

fedders

ARCHITECTURAL AND MECHANICAL SPECIFICATIONS

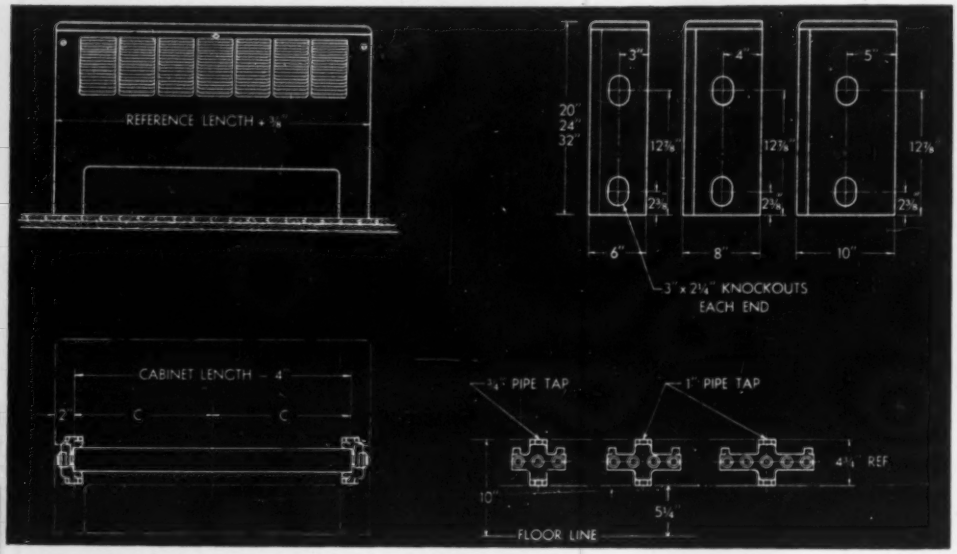
HEATING ELEMENTS — Convector-Radiator heating elements to be of type suitable for two pipe steam or hot water heating systems. They shall be fabricated of seamless copper tubes, aluminum fins, cast iron headers and galvanized steel side plates. Each header must have standard pipe tap inlet and outlet connections at top and bottom of each end. Holes in fins shall have die-formed flanged collars for large-area contact with tubes. Collars shall also serve as spacers between fins. Tubes shall be mechanically expanded into fin collars to provide metal-to-metal contact between tubes and extended surface. Tubes are to be permanently expanded into headers by means of power driven brass ferrules.

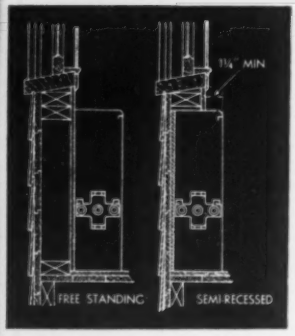
CONVECTOR-RADIATOR CABINETS—Type F Convector-Radiator cabinets, with or without dampers as specified, are to be fabricated with back and ends of USS 20 gauge steel. Material for top and front to be USS 18 gauge steel. Exposed corners and edges to be rounded to ⅜" radius. Front panels to be removable and to be held in position by two shoulder rivets at bottom and two quarter-turn quick acting fasteners at top. Integral grilles shall be of die-formed directional louver design. Edges of lower section of cabinet shall be of angle formation to provide formed base and eliminate raw edges. Entire cabinet and front panel shall be finished inside and outside with one coat of oven baked primer. Entire unit including cabinet and heating element to be manufactured by the same company. Provision shall be built in for readily adjustable pitch for proper return of condensate. Knock-outs shall be provided on each end of cabinet for convenient piping.

In addition to Type F Convector-Radiators, Fedders offers America's most complete line of other models for wide variety of special applications to suit every installation requirement.

FEDDERS-QUIGAN CORPORATION, BUFFALO 7, N. Y.

DIMENSIONS fedders Type F CONVECTOR-RADIATORS





Cabinet reference lengths are; 20", 24", 28", 32", 36", 40", 44", 48", 56", 64". Actual cabinet lengths are always ⅜" longer than the reference length. The heights are exactly 20", 24", 32". Depths are exactly 6", 8", 10".

Cabinets can be recessed any distance up to 1¼" from the front as shown. This permits easy removal of the front panel. Recesses should be constructed ½" longer than overall length and ¼" higher than height of the unit to be installed. If a convector is recessed into an exposed wall the back of the recess should be covered with ½" insulation.

Side connections should be avoided on recessed installations when units with 6" depths are used.

Heating elements are fastened into the cabinets 5¼" from the bottom.

To obtain pitch, loosen screws at desired end until element is lowered ¼".

DIMENSION C	REFERENCE LENGTH									
	20"	24"	28"	32"	36"	40"	44"	48"	56"	64"
6" Depth	8 3/16	10 3/16	12 3/16	14 3/16	16 3/16	18 3/16	20 3/16	22 3/16	26 3/16	30 3/16
8" Depth				14 3/16	16 3/16	18 3/16		22 3/16	26 3/16	30 3/16
10" Depth					16 3/16	18 3/16		22 3/16	26 3/16	30 3/16

Fedders Type F Convector-Radiators are shipped with heating element mounted in cabinet, ready to install as a complete unit. They are packed in cartons and properly labeled for easy identification both in the stockroom and on the job.

Heating, Piping and Air Conditioning

fedders

A GREAT NAME IN COMFORT

FEDDERS-QUIGAN CORPORATION

BUFFALO 7, N. Y., U. S. A.

It's time we got *working* mad!

As we listen to the latest insults from Moscow, we're likely to get fighting mad.

Instead, we'd better use our heads and get *working* mad.

It is clear by now that Stalin and his gang respect just one thing—strength. Behind the Iron Curtain they've been building a huge fighting machine while we were reducing ours. Now we must rebuild our defenses—*fast.*

As things stand today, there is just *one* way to prevent World War III. That is to re-arm—to become strong—and to stay that way!

This calls for better productivity all along the line. Not just in making guns, tanks and planes, but in turning out civilian goods, too.

Arms must come first. But we must produce arms *at the same time* we produce civilian goods.

We can do this double job if we all work together to turn out more for every hour we work—if we use our ingenuity to step up productivity.

All of us must now make sacrifices for the common good. But we're working for the biggest reward of all —*peace with freedom!*

THE BETTER WE PRODUCE THE STRONGER WE GROW

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Heating, Piping & Air Conditioning

The Greeks had a word for it... εὐπάθεια!

(comfort)

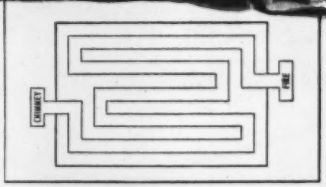
For the "comfort" of radiant heat today steel pipe is first choice—

Self preservation is the first law of nature and man's urge to seek comfort is part of it. Civilizations long extinct knew that, too. The ancient Greeks had a word for it which means the same but doesn't look nor sound as warm and friendly as our own word "comfort."

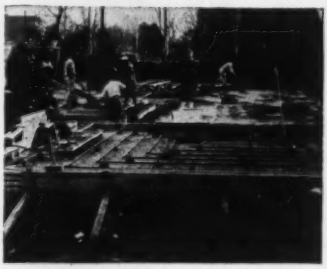
But in whatever language you say it, one of the ways of attaining comfort is by keeping warm, and the Ancients knew about radiant heating centuries ago. By passing smoke and hot gases from their fires through ditches and ducts, they warmed the floors and radiated heat throughout their homes.

Today radiant heating brings sun-like warmth to every room, in a completely scientific and effective way, by circulating hot water through embedded steel pipe coils. Proved through more than 60 years of service in conventional hot water heating systems, steel pipe has every quality required by modern radiant installations . . . low cost, strength, weldability, formability, and complete suitability.

Yes, if the Greeks had known about it they would have had words to say "steel pipe is first choice," too.

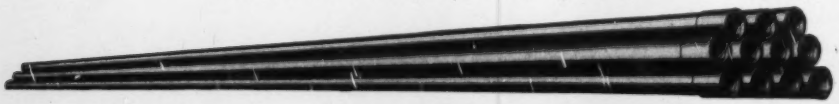


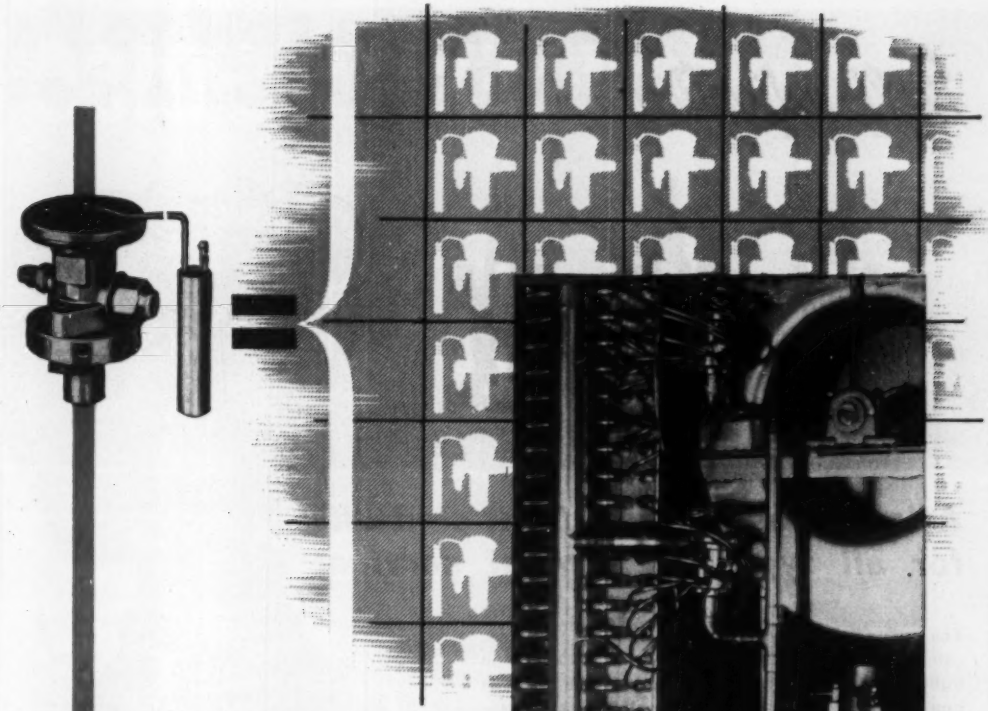
The ancients utilized channels beneath their floors to draw hot gases through from firebox to chimney, as shown above, thus warming floors.



Today steel pipe coils are embedded in floors or ceilings during initial construction to provide advantages of radiant heating.

COMMITTEE ON STEEL PIPE RESEARCH
AMERICAN IRON AND STEEL INSTITUTE
350 Fifth Avenue, New York 1, N. Y.





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On multiple circuit systems, only the Alco Multi-Outlet Valve assures these results:

- equal distribution regardless of load changes • stable control
- increased coil capacity • higher operating suction pressure
- greater utilization of machine capacity

For all refrigerants; ½ to 50 tons "Freon-12"; 2 to 36 outlets. Used by all major contractors and manufacturers of refrigeration equipment.

Full details in Bulletin 180.

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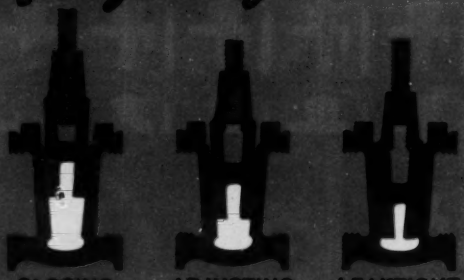
4600

Self-adjusting FLEXITITE DISC



Affords positive leaktight shut-off for all types of general service

You are one step ahead when you specify Ohio Brass gate valves. The Flexitite Disc® provides 100 per cent tight shut-off on all types of general service, yet you don't pay a premium price. Specially designed, the disc lifts clear to permit full unrestricted flow through the oversize valve port, and is absolutely leaktight in the closed position.

This unique disc is self-adjusting because only the outer disc edges have been sawed to permit a slight flexibility but solid wedge strength is retained by two connecting posts which join the disc faces. Closing the valve squeezes the wedge-shaped disc into the seat slot. The slight flexibility (exaggerated in diagram above) allows the disc to adjust itself to any minor irregularities, and to form an all-around metal-to-metal seal between seat and disc. A seal that remains leaktight even on hard-to-hold liquids like gasoline.

Your nearby Ohio Brass Company distributor carries a full line of Ohio Brass gate valves featuring the Flexitite Disc. He will be glad to discuss any of your plumbing and heating problems with you.

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O-B No. 25 Line ¼ to 3-inch size. Also available with solder-type ends, ⅜ to 2-inch sizes. Both types can be furnished with conveniently placed drain plug.

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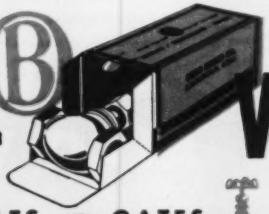

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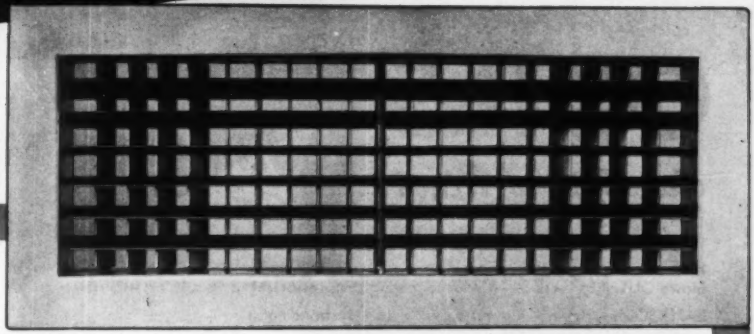

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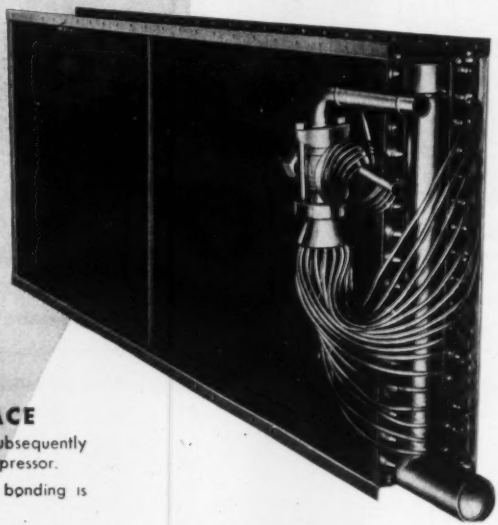

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SAFER COIL—Having withstood 3000 psi for bonding is safe-guarded against leaks.

UNIFORM EVEN STRESS—in ALL fins—good mechanical and thermal bond.

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Frames up to 72" are ALUMINUM. Larger sizes framed in steel, hot-dipped galvanized AFTER FABRICATION.

ONE-PIECE FINS (ALL LENGTHS)

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*Underwriters Laboratories Approval**

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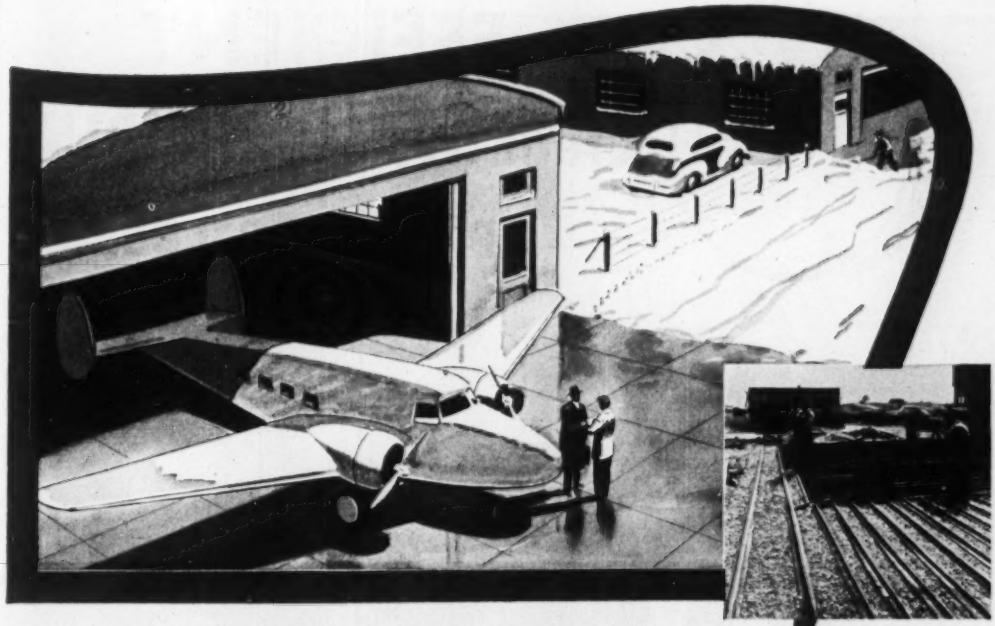

The snow-shoveling system has changed... but the name on the pipe is an old one...

SPANG CW

Shoveling snow is slow, inconvenient, and labor-consuming. But the owner of an underground snow-melting system gets rid of snow as fast as it falls, merely by opening a valve.

When you're installing a snow-melting system, specify "Spang CW Steel Pipe" . . . the ideal economical pipe for all closed heating systems. It's equally good under asphalt or concrete, and lasts for years in any location.

Your men will like the way Spang CW Steel Pipe fits up . . . it bends easily and smoothly, is easy to cut and weld. And its uniform high-quality assures good, tight installations.

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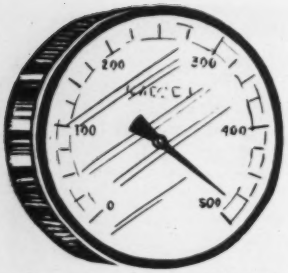

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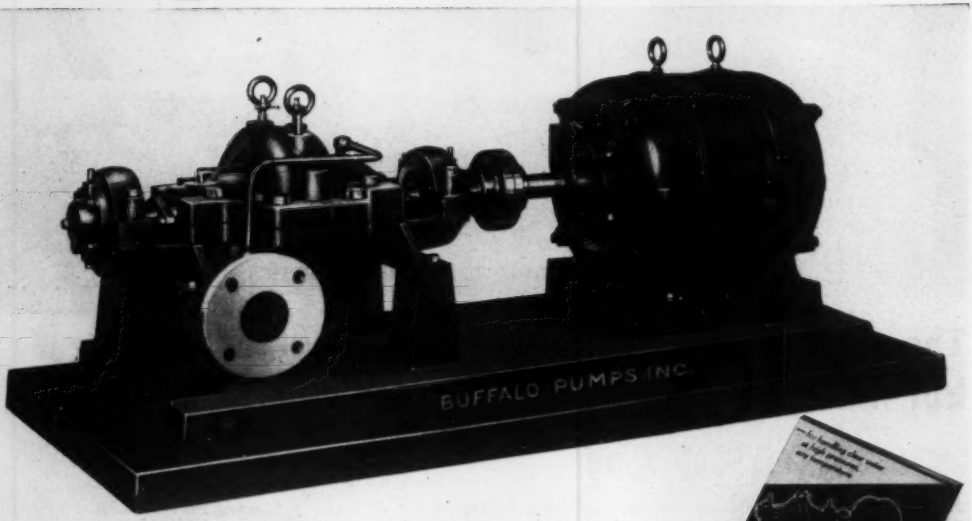
UP TO 500 LBS.



"Buffalo" **CLASS "RR" PUMPS**

For boiler feed and other clear water service where high pressures are encountered, "Buffalo" Class "RR" Pumps are a top value! On-the-job efficiencies are high. And, of prime importance to the user, these pumps are built to last. The photo above of a 2-stage "RR" shows the ample, heavy base, the oversize bearings and shaft, the generous thickness of the pump casing. All other parts are equally heavy-duty. WRITE FOR BULLETIN 980-B for the complete picture on "Buffalo" Class "RR" Pumps. They're available in 2- and 4-stage models with capacities up to 900 gpm.

"Buffalo" PUMPS

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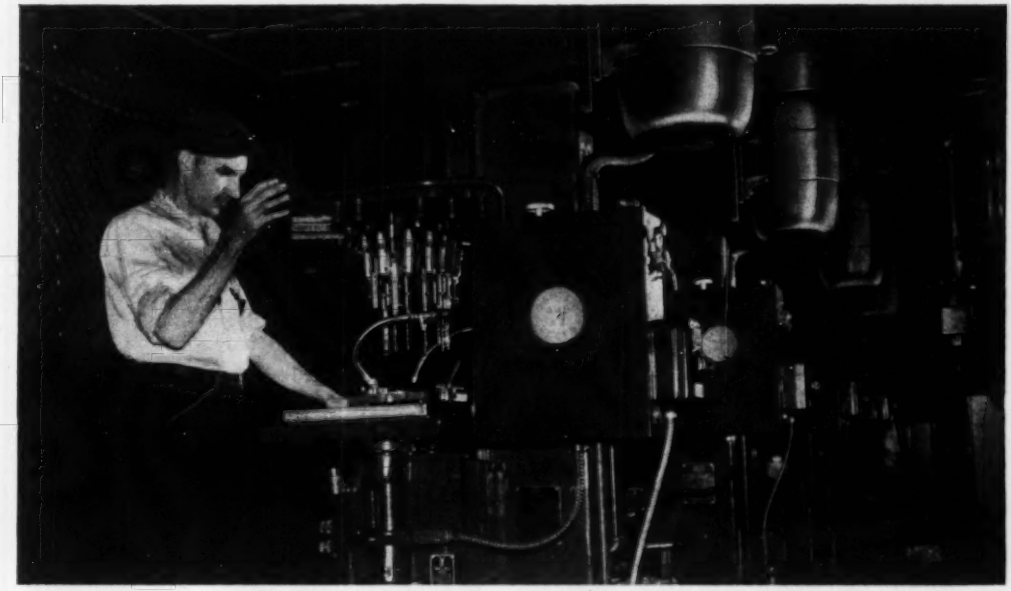

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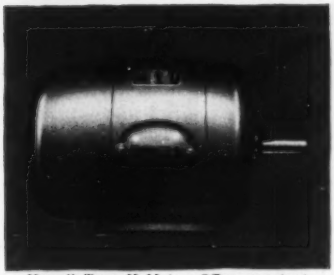
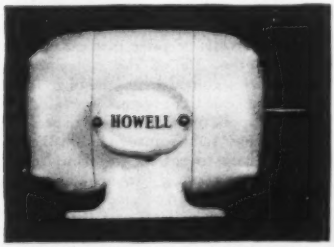


Howell Type K Motor. Offers constant performance in the presence of dirt, dust, fumes and moisture. Sizes from 3 to 150 H.P. at 1800 R.P.M. Either vertical or horizontal mounting.



Howell Sanitary Motors meet the most exacting standards of the dairy and food industries. They contain no pockets, cracks, or crevices. Available for vertical or horizontal mounting.

The actual cost of the motors you see pictured here amounts to hundreds of dollars.

But their true worth, in terms of supplying the power for these multiple drill spindles to turn out finished parts, runs into thousands.

It's tough applications like this which prove the real value of Howell Industrial Type Motors. For your jobs, Howell serves three ways: (1) by engineering electric motors to your job; (2) by furnishing motors of the highest quality; (3) by serving you after the sale.

May we apply our facilities and engineering ability to your problems?

HOWELL ELECTRIC MOTORS COMPANY

Howell, Michigan

HOWELL Red Band MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

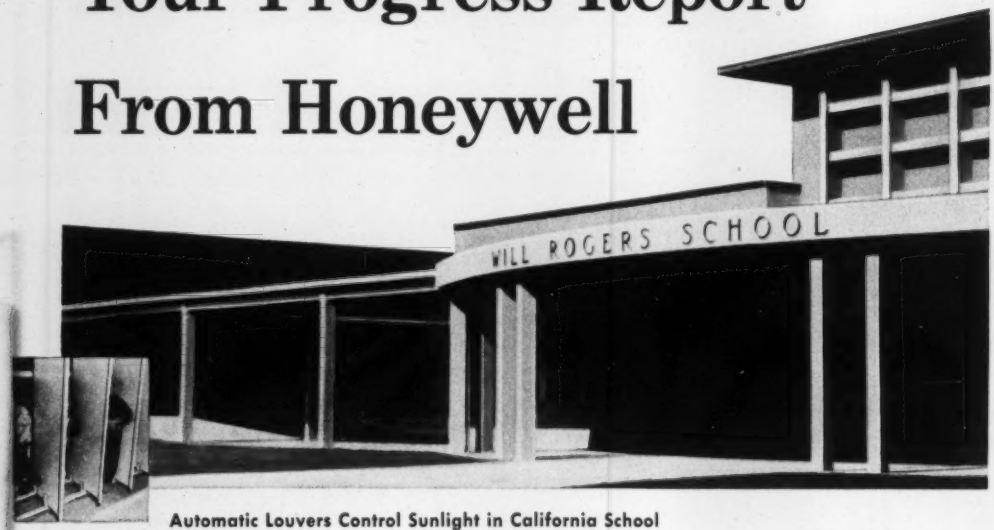
Precision-built industrial motors since 1915

HOW DO YOU CONTROL SUNLIGHT AUTOMATICALLY?

WHAT'S THE NEWEST THING IN AIR CONDITIONING CONTROL?

HOW WILL TEMPERATURES HELP PATIENTS GET WELL AT ILLINOIS RESEARCH HOSPITAL? THIS IS . . .

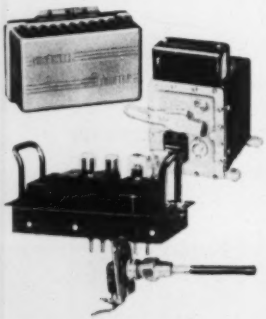
Your Progress Report From Honeywell



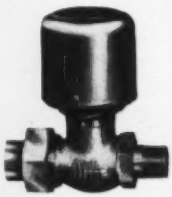
Automatic Louvers Control Sunlight in California School

In planning the new Will Rogers elementary school in Ventura, Architect Harold E. Burket wanted to "bring inside" as much of the mild out-of-doors as possible. But California law says no direct sunrays shall enter a school building! These giant louvers in the clerestory that adjust *automatically* to changing sun and cloud conditions proved to be the answer. Honeywell engineers, working with Mr. Burket, designed and installed controls that make sure the louvers obey the law—and still let in the maximum amount of daylight.

NOW! Electronic Air Conditioning Control!



By applying electronics to air conditioning control, a new system has been developed that provides a new high standard of comfort. The electronic thermostat that controls heating and cooling in this new Honeywell system is up to *100 times more sensitive* than a mechanical thermostat. This means much faster reaction to changes in load; no temperature "over-shoot"; no waste of either warm or cool air. By specifying electronic air conditioning control you give your client the ultimate in comfort. And at the same time he's getting a system that helps pay for itself through increased efficiency and lowered maintenance costs.



"Midget" Radiator Valve Ideal Space Saver

When the design of a building calls for pneumatic heat control, you'll find plenty of use for the V0501—the Midget radiator valve that's only *one-fourth* the size of the conventional valve. Its compactness makes it ideal for concealed convectors—and for all other applications where you're pressed for space. And because of its small size, it's easier to install and simpler to maintain. Special internal features enable the V0501 to give true modulation of heat delivery and the highest kind of performance.

Trend in Home Heating Is to Zone Control

With the accent on freer living and the rambling house, zone control of heating has now become recognized as the most practical way to meet the varying temperature needs of different "areas" in the home. In the house above, for example, Architect David Searcy Barrow found the best plan was to set up separate zones for the living-dining area, the sleeping area and the utility area. And with a Honeywell thermostat strategically located in each of the three zones, the whole house can be kept at the right temperature—no matter how changeable the weather.

University of Illinois Research and Educational Hospitals

When the University of Illinois' new research hospital is completed on the school's medical campus in Chicago sometime this year, it will be equipped with medical science's latest and best instruments for probing the unknown.

Holabird & Root & Burgee,
Architects and Engineers, Chicago
Ernest L. Stouffer,
Supervising Architect, Urbana, Ill.

And playing an important part in helping to advance medical science will be Honeywell controls—controlling humidity, and furnishing the patients in each room with individual temperature control.

E. P. Heckel and Associates,
Special Consulting Engineers, Chicago
M. J. Corbov Company,
Mechanical Contractors, Chicago

MINNEAPOLIS
Honeywell
First in Controls

414 New Apartments—All With Personalized Heating Control

The Algonquin Apartments—made up of six of the country's finest functionally designed buildings—will be completed sometime this year on Chicago's South Side. Each of the buildings will have 69 apartments—and each apartment will be equipped with Honeywell personalized heating controls. And to make sure of trouble-free performance, the heating plant in each building will be controlled by a Honeywell Aquastat system.

Associated Architects: Herbert S. Greenwald, Sponsor
Pace Associates, Chicago
Ludwig Mies van der Rohe, Chicago

* * *

For additional information on any of the installations or products in this report, call your local Honeywell office. Or fill in coupon below and mail it to us *today*.

MINNEAPOLIS-HONEYWELL
REGULATOR CO.
Dept. HP-4-23, Minneapolis 8, Minn.

Gentlemen:
Please send me further information on

- ☐ Electric air conditioning control.
- ☐ Midget Radiator Valve.
- ☐ P H C for apartments.
- ☐ Zone control for homes.
- ☐ Hospital heating and air conditioning controls.

Name_____

Firm Name_____

Address_____

City_____

Zone_____ State_____

Precision Built . . . for Star Performance

ACCURACY . . . PRECISION . . . exactness. These terms are important in measurements as distant as a star, or as near as the motor that powers your product. In the down-to-earth field of competitive selling, these terms mean efficient, long-term performance for your products, a selling advantage only precision motor manufacture can give.

America remembers . . . and in the months ahead will look for products that are built to last. Realizing this, Emerson-Electric continues its 61-year policy of exhaustive research, scientific design and precision production to build motors that *last.* In this way Emerson-Electric and its customers will continue to meet the demand for quality merchandise.

If you are looking for dependable motor performance in the 1/20 to 5 h.p. range, get the facts about precision-built Emerson-Electric Motors. Simply write:

THE EMERSON ELECTRIC MFG. CO.
St. Louis 21, Mo.

EMERSON-ELECTRIC'S unique
Twin-gineering
SERVICE
solves your power problems

Emerson-Electric Engineers are eager to collaborate with your own staff in designing and providing the proper motor application to your new or improved appliance or equipment. "TWIN-GINEERING" can save you costly engineering "back-tracking," and may suggest short cuts or improvements of great competitive benefit to your product. Write today for Free bulletin No. 123.

EMERSON ELECTRIC
MOTORS • FANS APPLIANCES

Wing

THE first overhead suspended unit heater discharging vertically downward was the Wing Featherweight Unit Heater with stationary discharge outlets. The first unit heater with revolving discharge outlets was, and still is the Wing Revolving Unit Heater.

Only by means of the slowly revolving discharge can a room or building be heated evenly, thoroughly and comfortably. No fixed discharge outlet, however complicated, adjustable or replaceable, can distribute the warmed air throughout the working area without causing uncomfortable hot blasts or leaving cold spots—or doing an inadequate job of heating.

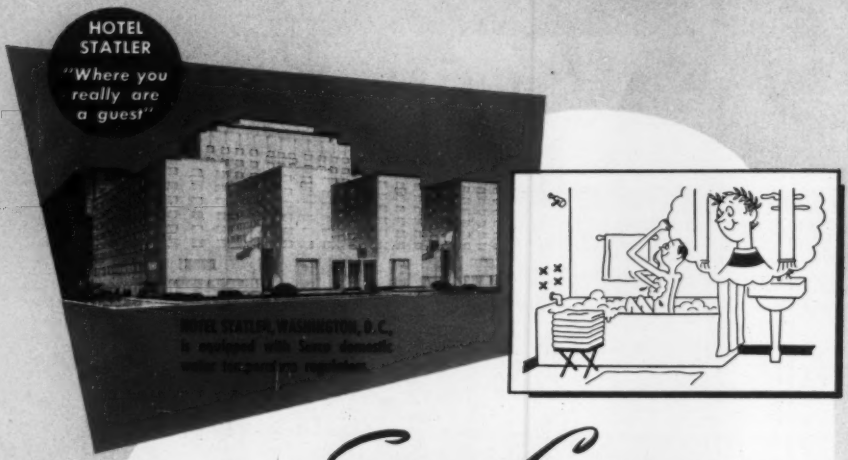
The Wing Revolving Heater, by means of its slowly moving discharge outlets, lays an even, gently stirring blanket of pleasantly warmed air over the working area, searching out remote corners, moving around and under obstructions and creating a healthful, live, invigorating atmosphere for the workers.

If you want specific information, consult Sweet's Catalog Files for the name of the nearest Wing Representative, or write direct.

L. J. Wing Mfg. Co., 149 Vreeland Mills Road, Linden, N. J., U.S.A.

Factories: Linden, N. J. and Montreal, Canada

European Representative: WANSON, *Haren-Nord, Brussels, Belgium*



Even Caesar

would have cheered a bath like this...

THERE'S A REASON Next time you chuckle over one of these clever Statler cartoons in your favorite magazine, remember that there's a reason for the plentiful supply of hot water for the guest's bath:

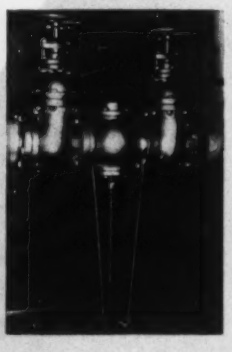
SARCO TEMPERATURE REGULATORS on all hot water heaters, as for example at this new Statler in Washington, D. C. These regulators include one 6", three 4" and one 3" Sarco Type TR-21.

For more than 25 years, Sarco self-operated Temperature Regulators have been used as standard equipment on storage type hot water generators.

For water always hot enough, never too hot, specify Sarco.

***New* bulletin No. 603 lists temperature controls for every type of water or oil heater.**

Sarco Type TR-21 self-operated Temperature Regulator with flanged valve. Liquid expansion provides the dependable operating force.



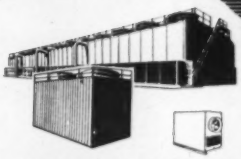
Front of a horizontal storage water heater in the Hotel Statler, Washington, D. C., showing the 4" Sarco Regulator installed thereon. All five water heaters are equipped with Sarco Temperature Regulators.

SARCO COMPANY, INC.

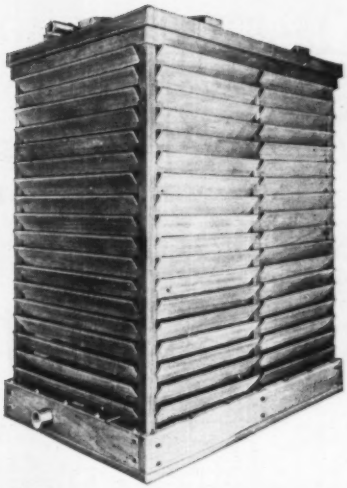
EMPIRE STATE BUILDING, NEW YORK 1, N.Y.
SARCO CANADA LTD., TORONTO 5, ONTARIO

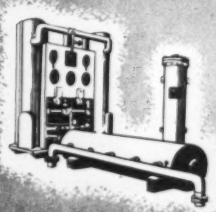
REPRESENTED IN PRINCIPAL CITIES

336



COOLING TOWERS





GAS EQUIPMENT

AIR COOLED
HEAT EXCHANGERS

Here's Why

You'll Want to Specify *The* Pritchard "SRF" TOWER!

Low cost Pritchard Series "SRF" Cooling Towers are especially designed for air conditioning or refrigerating installations requiring 3 to 24 tons capacity. Louver boards, louver posts and top framing are made of finest California Clear-Heart Redwood for *long life.* Steel pipe distribution system assures efficient, *trouble-free* performance.

"SRF" Towers are shipped complete with basin. "Slip-fit" construction gives easy access to interior of tower. All bolts, nuts, washers and nails needed for complete assembly are included. Full instructions furnished for quick field assembly.

For lowest initial cost, longest life, greatest efficiency, specify and install the Pritchard "SRF" Tower! Your inquiry invited.

Write for *FREE* Bulletin No. 5.9.081

Producers of QUALITY Specialized Process EQUIPMENT

EQUIPMENT DIVISION

J.F. Pritchard & Co.

Dept. No. 56 — 908 Grand Ave., Kansas City 6, Mo.

District Offices

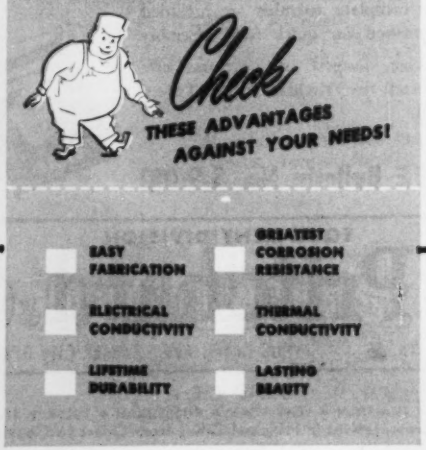
CHICAGO • HOUSTON • NEW YORK • PITTSBURGH • TULSA • ST. LOUIS

Representatives in Principal Cities from Coast to Coast

Product improvement and lower cost are two direct routes to increased sale-ability . . . and in many applications, Hussey Copper provides the answer on both counts.

Designing with this ageless metal assures both lifetime durability and lasting beauty . . . along with outstanding corrosion resistance and unmatched electrical and thermal conductivity. In addition, Hussey Copper offers the cost-cutting advantage of easy forming and fabrication, and rapid assembly by brazing, crimping, riveting, bolting, or laminating to other materials.

Adaptable Hussey Copper is available in shapes, sizes and gauges to meet every need.



Sheet . . . Strip . . . Coils . . .
Fabricated Products (Rods . . .
Wire . . . Tubing . . . Nails)

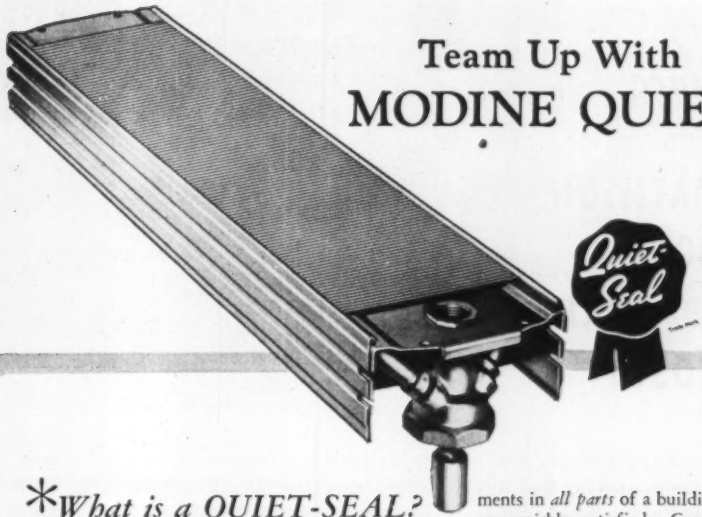
HUSSEY

C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES: PITTSBURGH, PA.

7 convenient warehouses to serve you
PITTSBURGH, 2850 Second Avenue • CLEVELAND, 5318 St. Clair Avenue • NEW YORK, 140 Sixth Avenue • CHICAGO, 3900 N. Elston Avenue • ST. LOUIS, 1620 Delmar Boulevard • PHILADELPHIA, 1632 Fairmount Avenue • CINCINNATI, 424 Commercial Square

If you're planning to use ONE-PIPE STEAM to cut installation and maintenance costs . . .

Team Up With MODINE QUIET-SEALS*



*What is a QUIET-SEAL?

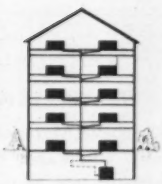
"Quiet-Seal" is the trademarked name of a Modine Convector *designed specifically for use on 1-pipe steam systems.* Patented heating unit (above) provides fast, smooth, quiet performance at full-rated capacity. Because steam, condensate (and air, when present) all flow in one and the same direction, the basic causes of water-hammer, gurgling and spitting of air-vents are eliminated. Free and easy venting prevents air binding or water-logging . . . a cause of slow response and reduced capacity.

Many thousands of Modine Quiet-Seals now in service, prove conclusively the possibility of providing excellent 2-pipe convector performance on 1-pipe steam systems.

Quiet-Seals Improve 1-Pipe Steam Performance — By permitting superior temperature control and system balance, Quiet-Seal Convectors greatly improve 1-pipe steam performance.

Having approximately 1/17th of the metal mass and 1/20th the internal volume of an average cast iron radiator, Quiet-Seals heat up many times faster . . . and as a result . . . almost simultaneously.

With Quiet-Seals, a 1-pipe steam system can be brought up to temperature much more rapidly than with ordinary radiators. Temperature requirements in *all parts* of a building are quickly satisfied. Consequently—unbalanced performance, caused by excessively long heating-up periods, is avoided . . . and the difficulty of providing satisfactory temperature control is eliminated.



Damper Modulated Heat Delivery for Comfort and Economy — Personalized room temperature control by manual adjustment of convector dampers eliminates expense of valves . . . discourages wasteful over-heating. When valves are used on 1-pipe steam radiators, they must be of the "on-and-off" type which do not permit modulation of heat delivery. *Only convectors offer this important refinement in 1-pipe steam heating.*

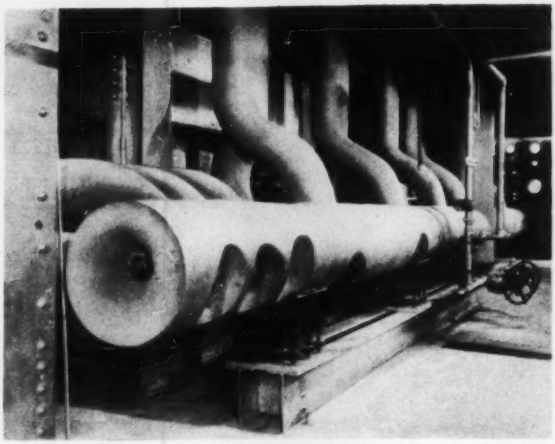
Free Bulletin Available — *For additional information on Modine Quiet-Seal Convectors and 1-pipe steam heating, get new Bulletin 250-B. Call your Modine representative . . . listed in the classified section of your phone book. Or write to Modine Mfg. Co., 1509 Dekoven Ave., Racine, Wisconsin.*

R-1102

Modine CONVECTORS

In every temperature range—

KEASBEY & MATTISON INSULATIONS DELIVER MORE HEAT AT LESS COST!



Boiler and furnace header in the Riverside Power Plant, Lake Charles, La., of the Gulf States Utilities Corporation, Beaumont, Texas. **Insulation Contractor:** Armstrong Cork Company.

Whatever your heat insulation problem, you'll find a Keasbey & Mattison covering that will solve it better. Consider the two K&M Insulations used in the above installation, for instance:

"FEATHERWEIGHT" 85% MAGNESIA

Keasbey & Mattison "Featherweight" 85% Magnesia withstands temperatures up to 600° F. without loss of insulating value. It is structurally strong, yet exceptionally light in weight. Alternate heating and cooling, wetting and drying does not effect its insulating properties. Its thermal efficiency remains unaffected after years of service.

HY-TEMP COMBINATION

This efficient and practical insulation combines the high heat-resistant properties of Keasbey & Mattison Hy-Temp with the superior insulating qualities of "Featherweight" 85% Magnesia. This makes Hy-Temp Combination Insulation suitable for exacting temperature control up to 1900° F.

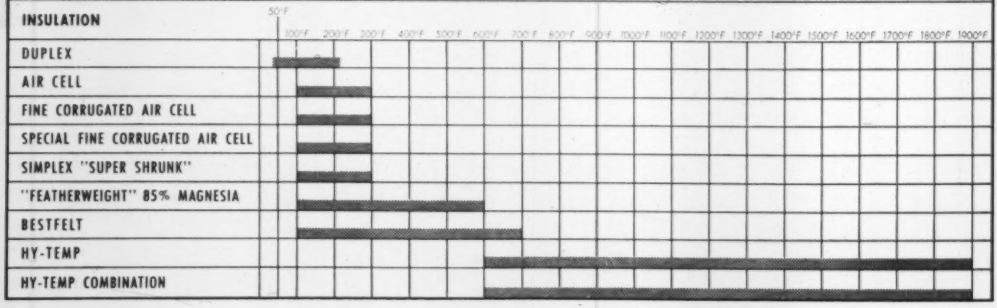
Your Keasbey & Mattison Distributor — who is an experienced applicator — will be glad to give you complete information on these or any K&M Insulations. Or, write us direct.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

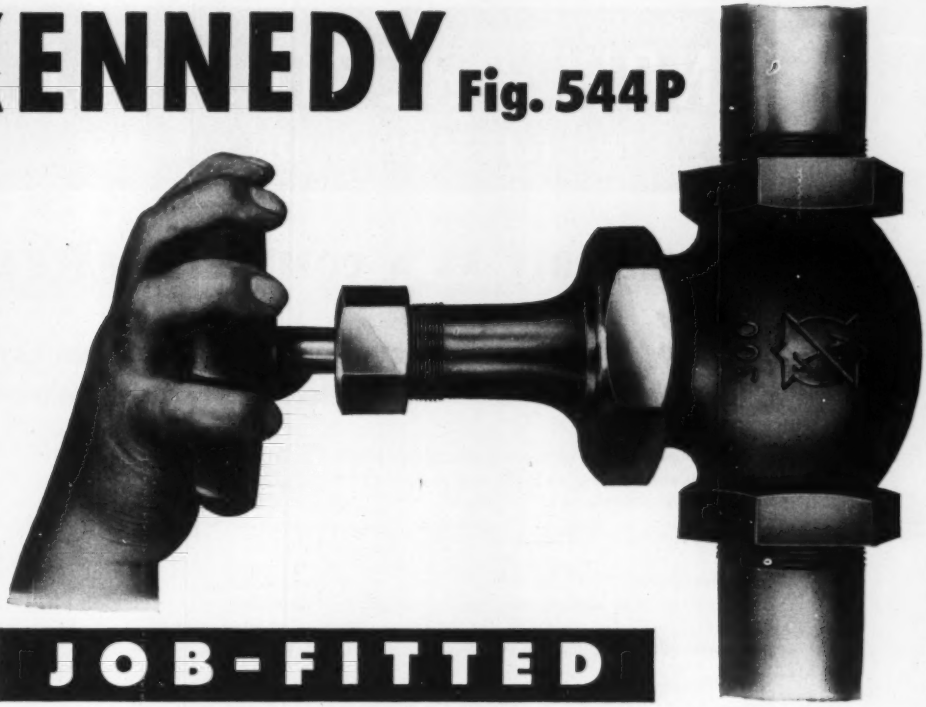
K&M best in asbestos ®

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

THERE'S A KEASBEY & MATTISON INSULATION FOR EVERY NEED



KENNEDY Fig. 544P



JOB-FITTED

for longer disc and seat life . . . where accurate control is a must

Like all valves in the complete KENNEDY line these bronze globe valves are JOB-FITTED . . . specially designed and engineered for the job they have to do!

UNION BONNET RING, heavy bronze section with extra thread engagement to assure a tight joint. Union bonnet makes a valve easy to dismantle and reassemble.

STEM, Naval Brass Rod, Acme threads, large diameter with extra thread contact . . . extremely resistant to wear.

PACKING, molded rings of graphited, wire-inserted asbestos designed for high pressure service.

PLUG TYPE DISC, nickel copper alloy, has extra wide seating surfaces for precise throttling control . . . is exceptionally resistant to scouring or wire drawing.

RENEWABLE SEAT RING, nickel copper alloy, ground to match disc in each valve to assure full bearing surfaces over entire contact area of each.

KENNEDY Fig. 544P, plug type disc, and Fig. 544, full-way disc, are designed for 300 lbs. steam, 600 lbs. WOG. Fig. 138P, plug type, and Fig. 138, full-way disc, for 200 lbs. steam, 400 lbs. WOG.

WRITE FOR BULLETIN 108

KENNEDY JOB-FITTED VALVES

THE KENNEDY VALVE MFG. CO.
ELMIRA, NEW YORK

VALVES • PIPE FITTINGS • FIRE HYDRANTS

NOW PRECIPITRON®...

THE ELECTRONIC AIR CLEANER

IS AVAILABLE AS A COMPLETE "PACKAGE"

Saves You **MATERIAL PROCUREMENT · ENGINEERING EXPENSE INSTALLATION EXPENSE · TIME AND MANPOWER**

Westinghouse PRECIPITRON, the electronic air cleaner, has long been used where clean air is a *must*. Its wide acceptance is due to three factors: 1) its design—*invented* by Westinghouse and developed through years of engineering and application experience; 2) its efficiency—*three times* more efficient than the *best* mechanical air cleaner; 3) its dependability—proved by countless installations.

In industrial plants and commercial buildings, soilage, contamination, or rejects caused by airborne dirt and foreign matter is eliminated by PRECIPITRON. Circulating air for individual rooms or for large areas of plants and office buildings can be made free of dust, dirt, pollen, and oil mist.

NOW, Westinghouse announces a new model which incorporates all the features of the standard line, and adds the convenience and money-saving advantages of a factory-designed, factory-matched *encased* unit.

HERE'S WHAT IT MEANS TO YOU:

Material Procurement Reduced. Everything you need is provided . . . no searching for scarce parts or supplies, or resorting to substitutes . . . 18-gauge casing and 10-gauge tank of galvanized steel assure rigidity; entering side baffles provide proper air distribution.

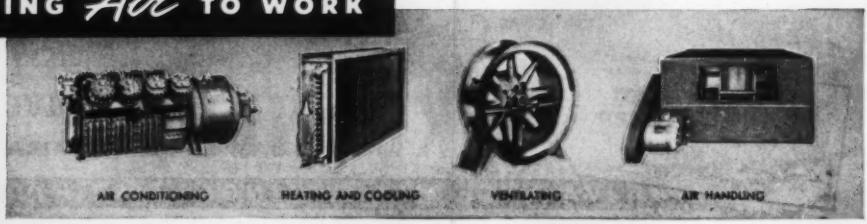
Eliminates Layout and Enclosure Design. Complete unit available in capacities from 8,000 to 44,000 cfm comes ready for assembly at the site . . . flanges punched for duct connections . . . sealed access doors with safety interlocks are pre-installed . . . all parts fit . . . even the hardware is included!

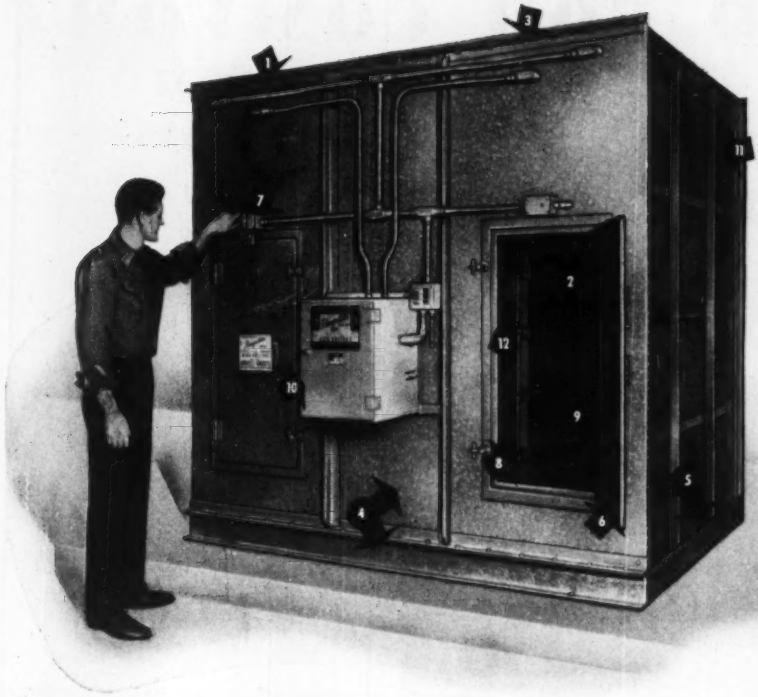
Masonry Work Reduced or Eliminated. Drain tank for flushing away collected dirt lays into place and unit bolts to it . . . range of 24 sizes from 8' x 5' x 5' to 8' x 10' x 11' permits matching to the job.

Saves Time and Manpower. Prefabricated parts, factory-matched, save assembly time and assure proper installation . . . highly skilled labor not required.

YOU CAN BE SURE... IF IT'S

PUTTING *Air* TO WORK



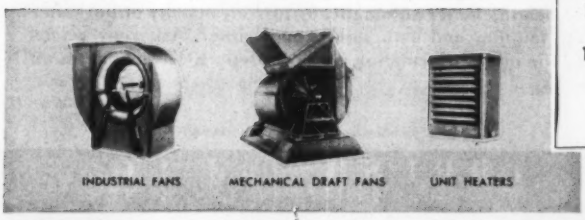


New Encased Precipitron Electronic Air Cleaner

Read about these and many other benefits such as accessibility, ease of maintenance, and undivided responsibility. Ask for application data DB 93-820 TODAY, and see for yourself how the PRECIPITRON Encased Unit can save you money. Westinghouse Electric Corp., Sturtevant Division, 132 Damon Street, Hyde Park, Boston 36, Massachusetts.

Write for booklet DB 93-820 today!

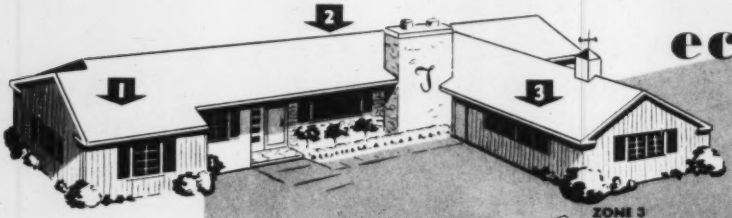
Westinghouse



CONSTRUCTION FEATURES

1. Furnished complete and ready for assembly . . . top, sides, and base with drain pan, prefabricated and factory matched.
2. 90% or 85% Blackness Test Efficiency.
3. 24 sizes, capacities from 8,000 to 44,000 cfm . . . standardized construction—8' length in direction of air flow; nominal heights, 5' to 10'; nominal widths, 5' to 11'.
4. 18 ga casing and 10 ga tank of galvanized steel and welded construction—hardware included.
5. Punched inlet and outlet duct flanges.
6. Right or left side access doors—sealed to eliminate leakage.
7. Door interlock switches for operator safety.
8. No moving parts—low maintenance.
9. Aluminum cell construction—corrosion resistant, easy to service.
10. Self-regulating power pack—low power consumption.
11. Entering-side baffles for proper air distribution—leaving-side filter frames optional.
12. Complete accessibility for inspection, washing, maintenance.

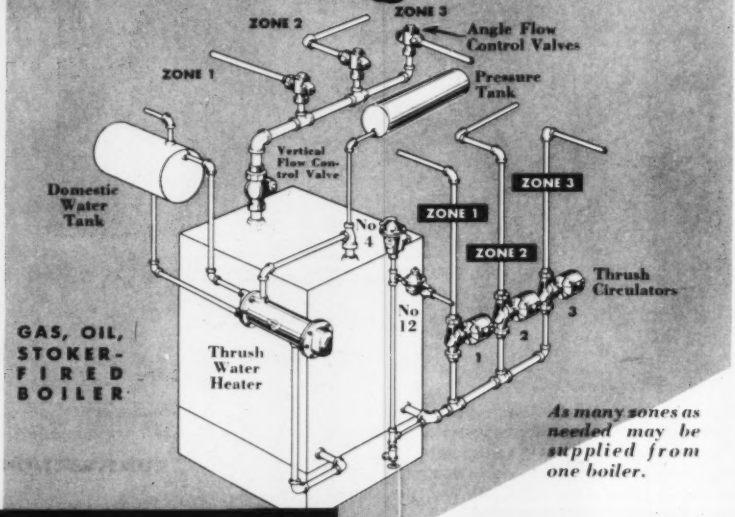
ZONED FOR COMFORT and economy!



ZONE 1—*Kitchen, Utility Room, and Servants' Quarters.*

ZONE 2—*Living Room, Den, Dining Room, and Game Room.*

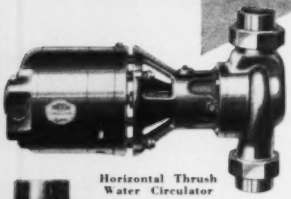
ZONE 3—*Bedroom Wing.*



As many zones as needed may be supplied from one boiler.

THRUSH forced circulating

FLOW CONTROL HOT WATER HEAT



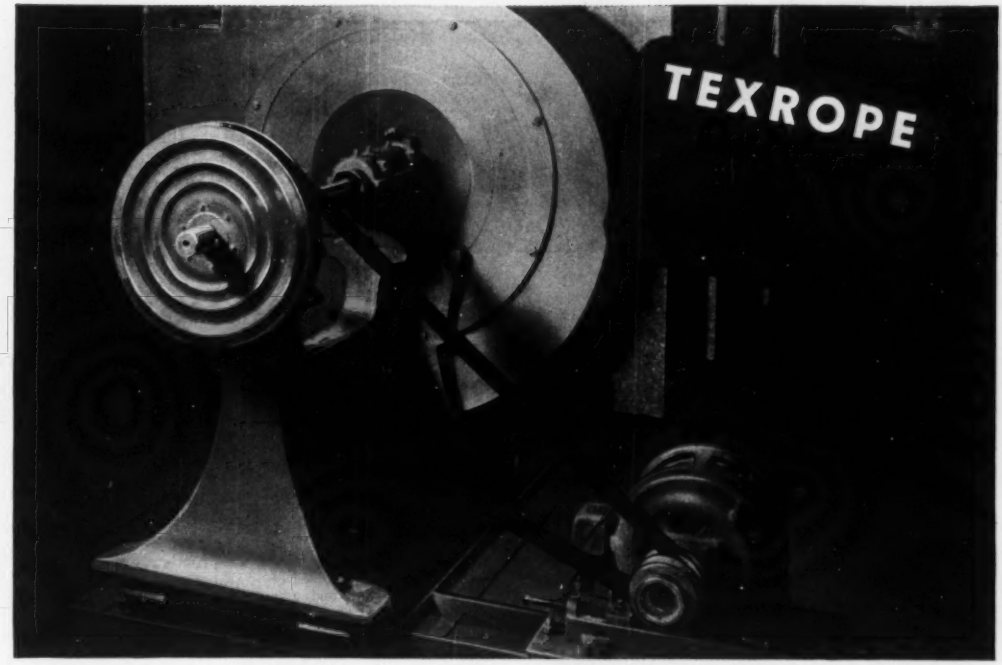
Horizontal Thrush Water Circulator

No. 201 Radiant Heat Control

Vertical Flow Control Valve with air tube.

ANY HOT WATER heating plant may be zoned easily and inexpensively with Thrush Flow Control System, to supply as many zones as are needed from a single boiler. These zones may be in the same house or in adjacent buildings, often greatly reducing equipment cost because the one boiler replaces many. Only a Circulator, with Relay Transformer, Flow Control Valve, and a Radiant Heat Control are added for each additional zone . . . simple units which give dependable and individual comfort control in each zone. Thrush Water Heater eliminates the need for separate domestic water supply as the same heating boiler automatically provides plenty of hot water for kitchen, laundry and bath summer or winter. Ask your wholesaler today for more information or write Dept. E-4 for bulletin on Zoned Heat.

H. A. THRUSH and CO.
PERU . . . . . INDIANA



Change Fan Speeds This Fast, Low Cost Way

ALL THESE ADVANTAGES are yours with *Vari-Pitch* drives:

1 There's a wide range of types and sizes to fit operating conditions. Big or small, Stationary control or Motion control types are available.

2 *Texrope* drives are noiseless and tend to dampen vibration of other parts.

3 It takes only a few minutes to change the speed of a fan equipped with a *Vari-Pitch* Stationary Control drive. Takes even less time to balance and adjust system with Motion Control drives.

4 You get an infinite number of speeds from one sheave.

5 Speed of fan will not change once it has been set.

PLUS VALUES

One phone call brings you everything you need for your drive — motor, base, starter, sheaves and belts. In addition, you get the extra engineering help in field and factory that comes from Allis-Chalmers long experience. For A-C has more V-belt drive installations in industry than any other manufacturer.

Get one day, one call service on your next fan job by calling your nearest Allis-Chalmers Authorized Dealer or Sales Office, or write for bulletin 20B6082B, Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3327

***Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks.**

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Sold . . .
Applied . .
Serviced . . .

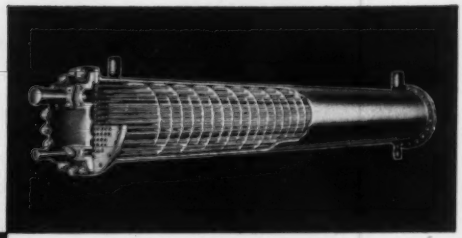
by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

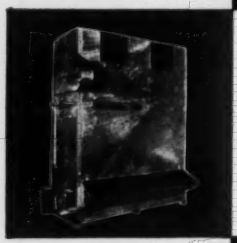
ACME PRODUCTS

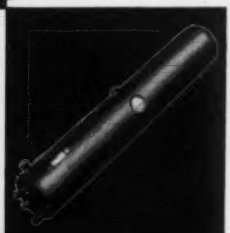


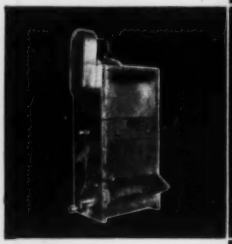
specify

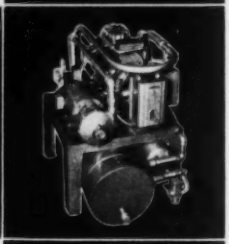
Acme

for engineering QUALITY and PERFORMANCE









When you specify "ACME" your equipment problem is greatly simplified, because the "ACME" Line is so complete that you will always find a product, model and size tailored to fit *every* refrigeration requirement.

DRY-EX* WATER CHILLERS

More than 700 combinations of heads, baffle spacings and tube lengths, capacities from 1 to 200 tons. High rate of heat transfer; replaceable tubes; optional choice of single or dual circuits on 12" or larger; positive oil return without the need for oil separator; improved head design, tube hole grooving, tube rolling and baffle construction, make ACME DRY-EX* Water Chillers *truly outstanding.*

EVAPORATIVE CONDENSERS

for Freon or Ammonia in more than 30 models with capacities from 120,000 to 1,250,000 BTU/Hr. Through tube construction; Electro tin plated baffles, Oil bleed connections provided if load drops below design load, Cast Steel Heads — these and other advantages exemplify the superior quality you get when you specify ACME.

ACME OIL SEPARATORS

Two separate series, Ten Models for Freon and six for Ammonia. ACME Oil Separators provide positive oil separation, are easily accessible, require practically no maintenance and help to muffle compressor discharge noise.

ACME CONDENSERS

Are noise-free, easy to clean and have leak proof joints. A complete line of Freon, Ammonia, Shell and Tube and Shell and Coil is offered. You can choose from more than 120 standard sizes to get the right model to meet *every* requirement.

ACME COOLING TOWERS

Available in capacities from 3 to 40 Tons. Induced draft design offers increased efficiency, with quiet operation and water saving features. Housing constructed from *11 and 14 Ga.* steel. NON-CORROSIVE Cooling Pads. Hot-dip galvanized *after* fabrication.

FLOW-COLD* LIQUID CHILLERS

Self-contained, compact and efficient Units completely wired and with refrigerant piping completed and tested at the factory. Can be used for heat-pump application where suitable heat source is available.

ACME LIQUID RECEIVERS

Offered in more than 70 standard sizes, from 6⅝"x18" to 30" x240", for Freon, Ammonia or other refrigerants — are easy to install and maintain.

HI-PEAK* WATER COOLERS

have large storage capacity and are galvanized *after* fabrication. Offered in seven standard sizes. For intermittent or continuous operation. EVERDUR Tank and factory insulation are optional.

BLO-COLD* INDUSTRIAL UNIT COOLERS

Five distinct series in more than 260 combinations with dry coil operation or continuous brine spray defrosting or for flooded Ammonia operation. Coils are easily accessible, fan sections are separable and large doors facilitate inspection. Hot Dip galvanized *after* fabrication.

Wherever refrigeration is used, ACME major components are in evidence and have deserved the preference of the Industry for more than 30 years — Write for Catalog and further information on any item required.

*Trade Mark

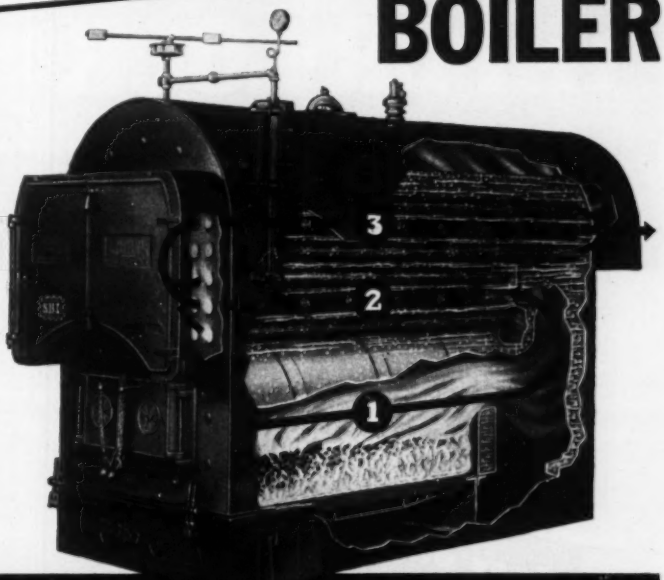
Acme INDUSTRIES. INC. JACKSON, MICHIGAN

CONTINUOUSLY SERVING THE REFRIGERATION INDUSTRY SINCE 1919

This is the Compact Type **STEEL BOILER**

with the famous

BURNHAM FIRE TRAVEL*



***3 times-back-and-forth fire travel means heat transfer is more efficient— you get more BTUs per unit of fuel!**

THE BURNHAM "COMPACT TYPE" Welded Steel Boiler with this famous feature is notable for low flue temperatures, high boiler efficiency and low fuel costs. Capacities for SBI Steam Hand-fired range from 3,000 to 35,000 sq. ft. and SBI Steam Automatic from 3,650 to 42,500 sq. ft.; SBI Hot Water Hand-fired range from 4,800 to 56,000 sq. ft. and SBI Hot Water Automatic from 5,840 to 68,000 sq. ft.

Long experience and intensive research have produced in this efficient BURNHAM Steel Boiler the last word in quality and dependability.

Some of its outstanding features are: Large steam dome permitting quick, easy steaming without priming. Rapid, continuous water circulation for efficient heat transfer. All sediment settles away from hot surfaces. Low water line for easy installation and piping. Plenty of clean-out plugs.

For schools, apartments, greenhouses and similar installations the BURNHAM "COMPACT" Steel Boiler provides dependable low cost heat. Send for 8 page catalog with full details and ratings.

Copper coils, storage or tankless type, can be installed in all sizes for an abundant supply of domestic hot water.

Burnham Corporation

"PIONEERS OF RADIANT BASEBOARD HEATING"

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Burnham RADIANT HEATING SINCE 1873

BURNHAM CORPORATION
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Please send copy of catalog SB-104 giving details and ratings on Burnham Steel Boilers.

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There's only one
TAPER-LOCK

Precision-Grooved

True Running

Easy on—Easy off

TAPER-LOCK bushing grips the shaft for the full length of the bushing — holds sheave with firmness of a shrunk-on fit. No wobble. Taper-Lock runs true!

No flange—no collar—no protruding parts. Flush machine-tool appearance.

Finest grade of close-grained semi-steel, cast in the Dodge foundry.

The grooves, machined on precision equipment, have identical pitch diameters. This insures equal belt tension. Every belt pulls its share of the load!

TAPER-LOCK sheaves are available from distributors' stocks in complete range of sizes in A, B, C and D grooves.

DODGE SEALED-LIFE BELTS have special protection for tension members, insuring longer belt life. Perfectly matched to TAPER-LOCK sheaves.

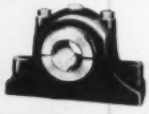
DODGE MANUFACTURING CORPORATION, 1600 Union Street, Mishawaka, Ind.

DODGE
of Mishawaka, Ind.

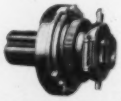
CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Equipment" in your classified phone book.

FIRST IN POWER TRANSMISSION MACHINERY!

V-BELTS AND TAPER-LOCK SHEAVES



DODGE-TIMKEN PILLOW BLOCKS



ROLLING GRIP AND DIAMOND D CLUTCHES

SOLID STEEL CONVEYOR PULLEYS

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO, ILLINOIS

Bundyweld Tubing shines in better radiant heating systems

Shines in *on-the-site* fabrication, too.

Bundyweld is the only tubing double-walled from a single strip, with an exclusive beveled edge. It is copper-brazed, perfectly bonded through 360° of wall contact, into a solid-walled tube with thinner yet stronger walls. It is held to close tolerances.

Scale-free and smooth inside and out, Bundyweld arrives at the building site in twenty-foot lengths, with one end expanded if specified.

One man quickly bends grids on a simple wood or metal form and joins them by soft or silver soldering. Two men easily position the lightweight, rigid, joined grids.

Bundyweld shines, too, in your radiant heating systems. It's extra sturdy with a margin of safety against leaks or bursts under normal pressure. Its thinner wall radiates heat faster for more effective performance.

You can already see that Bundyweld offers many unique performance and fabrication advantages that mean time, work, and money saved. But there are more. Check *Sweet's Architectural File* for details. Or write us. ***Bundy Tubing Company, Detroit 14, Michigan.***

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of basic metal, coated with a bonding metal. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Bonding metal fuses with basic metal, presto—

Bundyweld . . . double-walled and brazed through 360° of wall contact.

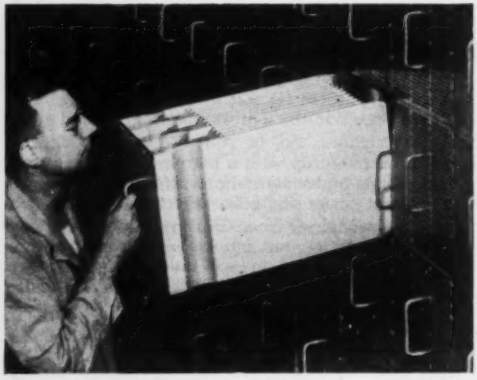
NOTE the exclusive patented Bundyweld beveled edge, which affords a smoother joint, absence of bead and less chance for any leakage.

FIELD REPORT

...actual quotations reporting on new Electromaze installation in Eastern Pennsylvania

CUSTOMER REPORTS: *"We are pleased with its operation, compactness and the fact that the cells can be removed for cleaning."*

CONTRACTOR REPORTS: *"It is the easiest and least expensive electric filter to install."*



EASIEST TO INSTALL! Electromaze is a new kind of electrostatic dirt precipitator made up of individual cells that slide in and out like filing cabinet drawers. Cellular steel frames come in pre-fabricated sections. All you do is bolt the sections together. Contractors report that Electromaze requires 50% less time and effort to install!

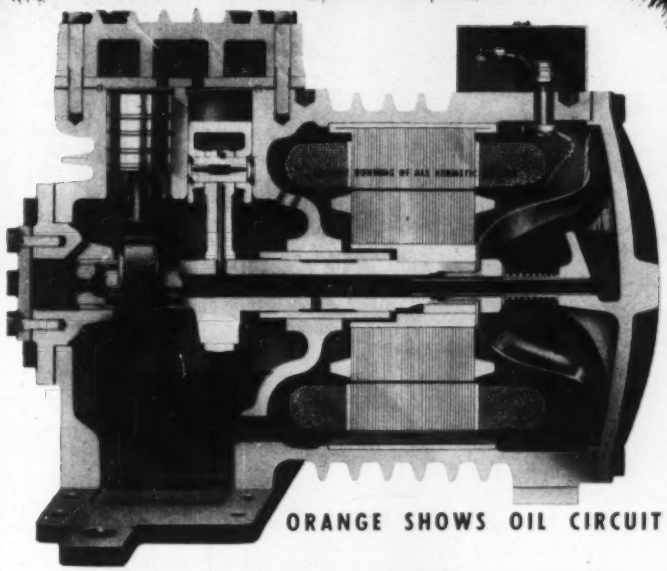
EASIEST TO CLEAN! Due to extra wide collector plate spacing in Electromaze cells, the filter can be quickly cleaned in place with a pressure hose. If manual cleaning does become necessary the cells can be readily removed for cleaning. Ask your Consulting Engineer or contact your nearby Air-Maze representative. Air-Maze Corporation, Cleveland 5, Ohio.

AIR FILTERS
SILENCERS
SPARK ARRESTERS

AIR-MAZE
THE FILTER ENGINEERS

LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

FOR QUIET, ECONOMICAL AIR CONDITIONING



ORANGE SHOWS OIL CIRCUIT

COPELAMETIC

The ACCESSIBLE Hermetic

Smooth, quiet Copelametic gives the greatest value for your air-conditioning dollar. Look over the BTU ratings and you'll see what we mean. Copelametic is the hermetic that combines all the finest features of all types of units. It is field-accessible . . . never a reason to return it to the factory.

Copelametic eliminates belts, seals and manual motor oiling. The cutaway illustration shows how oil reaches all bearing surfaces by forced-feed lubrication. The one-piece compressor and motor housing maintains perfect alignment for bearings and cylinders. Large integral cast fins around the housing dissipate heat rapidly for highest efficiency. In addition, motors are water-cooled above 2 H.P.

Copelametic units can be used on any application now served by open units. Motors for any standard currents. Models from 1/6 H.P. to 7½ H.P., inclusive.

WRITE, WIRE or PHONE for full details.

COPELAND REFRIGERATION CORPORATION · SIDNEY, OHIO

Manufacturers of

REFRIGERATION UNITS (OPEN-TYPE AND COPELAMETIC), WATER COOLERS, REFRIGERATORS

H&H means Quality and savings and Service in Brass and Copper Tubing

A TYPICAL REPORT:

"The expert care they use in finishing fabricated parts sold us on H & H"

Users of fabricated tubular parts know that when they buy from H & H, they buy precision. Every unit we deliver reflects the expert care with which it is fabricated. The machine which produced the piece shown above is but one example of the many facilities that H & H can employ to fabricate even the most complicated part. No matter how exact your requirements, you can be sure that H & H has the men, the methods and the machines necessary to give you the best in precision-finished fabricated parts.

Originators and sole makers of "Metalflo"— the economy tubing

H & H TUBE AND MANUFACTURING COMPANY

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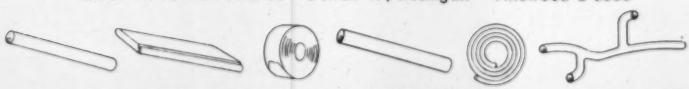

METALFLO • LOCKSEAM • COIL STRIP AND SEAMLESS TUBING • TUBULAR PARTS

NEW HEAT SAVING EFFICIENCY

Mundet 85% Magnesia Insulation provides attractive smooth finish . . . precise fit . . . maximum strength and resistance to vibration.

New heat saving efficiency is provided by Mundet Custom Molded 85% Magnesia Pipe Covering. Extra durability is built into this insulation. It is precision manufactured on the latest type of automatic equipment to insure uniform standards. It does not "powder", settle or disintegrate. It is unaffected by steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation when you specify Mundet 85% Magnesia Pipe Covering. Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7205 Tonnelle Avenue, North Bergen, New Jersey.

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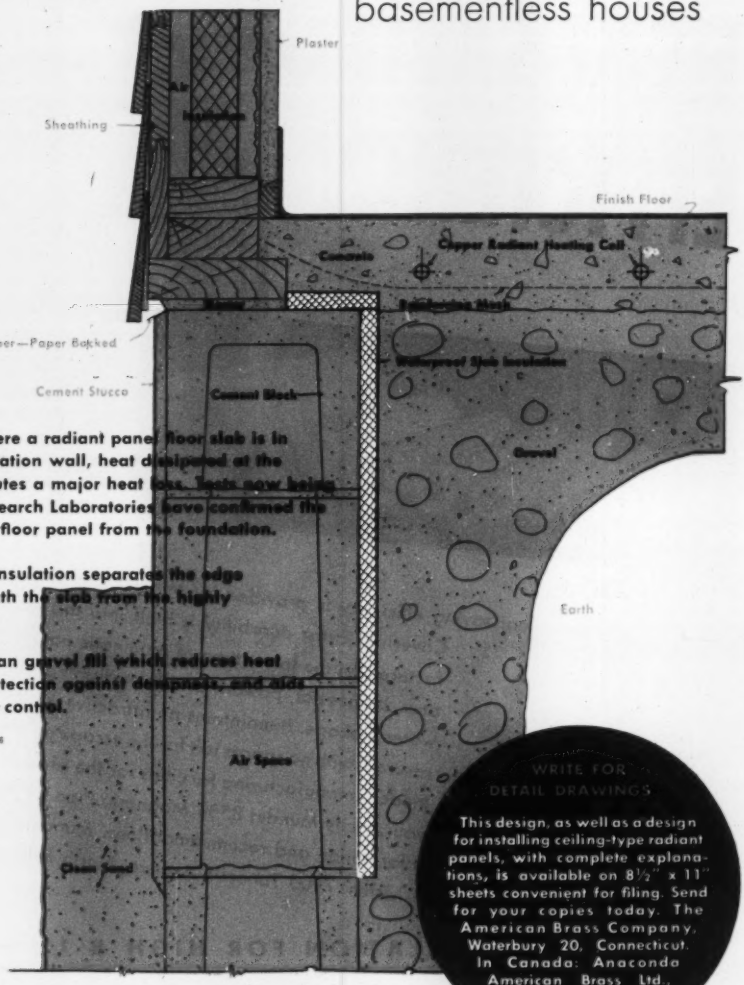
Write us for name of our nearest representative if there is no Mundet office in your city.

How to design to insulate against heat loss in radiant floor panels of basementless houses



In basementless houses, where a radiant panel floor slab is in direct contact with the foundation wall, heat dissipated at the perimeter of the slab constitutes a major heat loss. Tests now being conducted in the ASHVE Research Laboratories have confirmed the importance of insulating the floor panel from the foundation.

In this design a waterproof insulation separates the edge of the slab and the fill beneath the slab from the highly conductive foundation wall.

Note also the 6 inches of clean gravel fill which reduces heat loss to the ground, offers protection against dampness, and aids in more uniform temperature control.

5106

WRITE FOR DETAIL DRAWINGS

This design, as well as a design for installing ceiling-type radiant panels, with complete explanations, is available on 8½" x 11" sheets convenient for filing. Send for your copies today. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

***nothing serves like* ANACONDA® COPPER TUBES**

American Blower—a time-honored name in air handling

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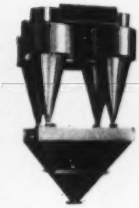
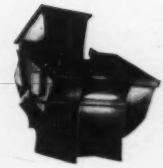


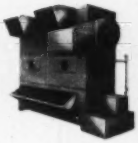
Dust Collectors



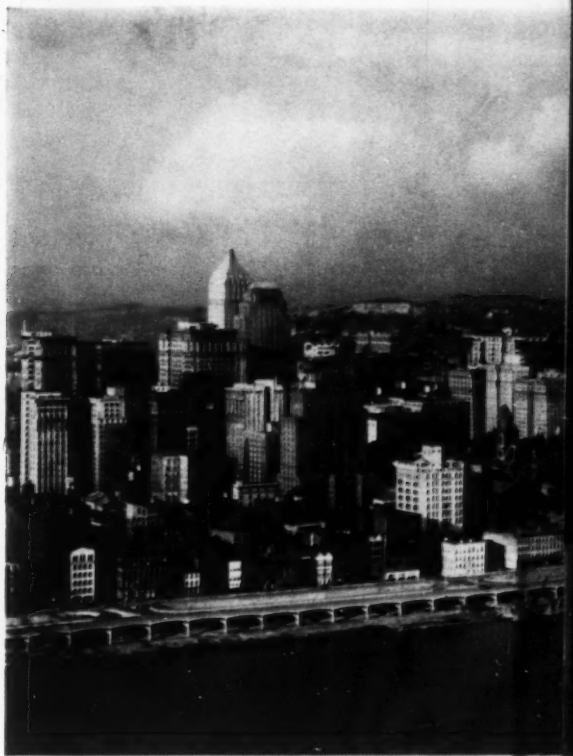
Mechanical
Draft Fans

Industrial Fans

Heating and
Cooling Coils



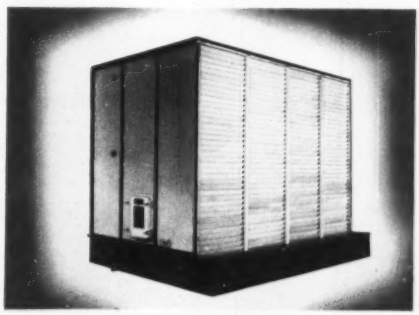
Air Conditioning
Equipment



All air handling equipment is not alike. There's a vast difference in quality, design, quietness, operating costs and efficiency. Look before you buy—and you'll buy American Blower products, the accepted standard and proved in test after test by buyers.

In Pittsburgh, as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the Pittsburgh area, call American Blower—Atlantic 1-3496. In other areas, consult your phone book.

Product of the month



American Blower Class 8 Air Washer and Dehumidifier

Cleaner, fresher air for your business!

Clean, washed air, properly humidified, is an asset to any business, especially during the hot summer months.

That's why we're placing special emphasis this month on American Blower Air Washers and Dehumidifiers.

Three standard classes are available: the Class 8 Air Washer and Dehumidifier—a highly efficient heavy duty unit with two banks of sprays in a casing 96 inches long; the Class 6 Air Washer—a single spray bank, intermediate capacity unit in a casing 72 inches long (this unit is ideal for most types of evaporative cooling and air cleaning jobs); the Class 4 Air Washer—a compact and economical single spray bank air washer with 48-inch casing length. It's designed specially for effective evaporative cooling and air washing in a minimum space.

In all, 86 standard sizes are available with capacities ranging from 5,550 to 117,350 cfm. For details, ask the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

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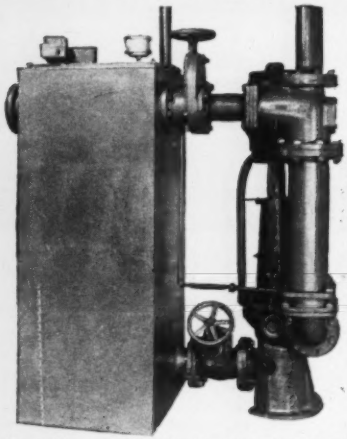
Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

For Every Service Within the Building

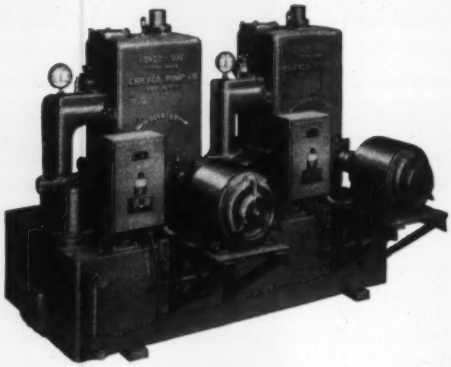
Specify Chicago PUMPS

FLUSH-KLEEN Sewage Ejector



Absolutely clog proof . . . impellers handle nothing but strained sewage, minimizing wear and maintaining pump balance. Specially designed for plumbing systems in buildings where maximum flow is not more than 50 GPM. A second unit can be added any time to make duplex installation.

CONDO-VAC Return Line Vacuum and Boiler Feed Pump

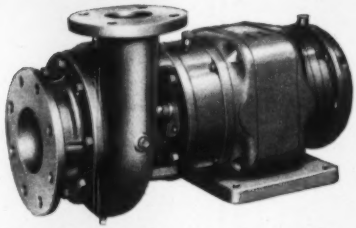


No vacuum on stuffing boxes, ample clearance in rotating member. It costs less to operate a "Condo-Vac." "Condo-Vac" reduces corrosion in piping and boiler to minimum—because pump does not take in air from atmosphere and entirely eliminates all air coming back from system. "Condo-Vac" is quiet, has a low inlet, entirely automatic, easy to maintain.

CHICAGO CIRCULATING PUMPS

Type "D"—For "Heavy Duty" Building Application.

The complete line of "Chicago" Pumps are built to give you exactly the type of service you want . . . efficiency . . . convenience . . . minimum operating and repair expense. Construction leaders everywhere endorse these "Chicago" pumps.



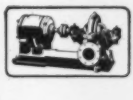
Type "N"—For "Light Duty" Building Application.

Write for data on our complete line of equipment.

CHICAGO PUMP COMPANY

BUILDING and INDUSTRIAL DIVISION

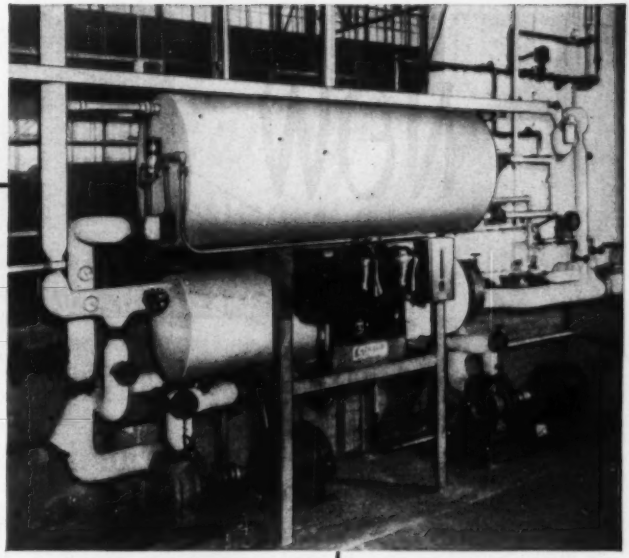
2300 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**



Condo-Vac, Sure Return. AVC, LVC, Fire, House & Circulating Pumps
Pneumatic & Tankless Water Systems

Flush-Kleen Sewage Ejectors
Little Giant & Non-Clog Bilge Pumps
Pumps for every industrial use.

SCHAUB
BOILER RETURN SYSTEMS

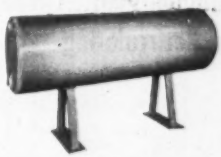


A duplex S5K-D Schaub deaerating type Boiler Return System in modern Chicago industrial plant. Equipment includes Model 2084 feed water heat exchanger, and serves a 200 HP, 200-lb. W. P. boiler.

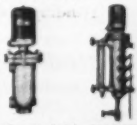
You Get All These Features ...in a SCHAUB

Only Schaub offers you the combined exclusive *money-saving* features illustrated at the right. Any one of these alone would be a sound reason for buying a Schaub System over any other. Take time to compare details. Then you'll quickly see why Schaub gives you *more* for your money on *every* feature. In terms of real savings—you get improved operating economy, lower maintenance costs and longer equipment life. All this means your return system costs you less per year. Know the facts and you'll readily recognize that a Schaub Boiler Return System is your best value.

Schaub Master-Bilt Turbine Pump
Patented fleximatic shaft seals and pre-lubricated ball bearings mean no packing and no greasing—ever! When you install a Schaub Master-Bilt Pump, you can forget about it.



Chromosoid-Lined Receiver
10-year guarantee against corrosion. Schaub engineers developed Chromosoid lining by working with leading chemical researchers. You're protected from costly and premature replacements. No more rust-clogged systems!



Ultra-Dependable MAGNETROL Boiler Water Level Control
Combination pump-control and low water safety cut-off. Friction-free Magnetrol, assures boiler safety. No bellows to stiffen, no packing in head, no tricky electrode circuits to fail. All models approved by Underwriters' Laboratories, Inc.

Get the Facts! The complete story of how much more you get when you specify a Schaub System is quickly presented in Catalog 55. Write for your copy NOW—it's free!

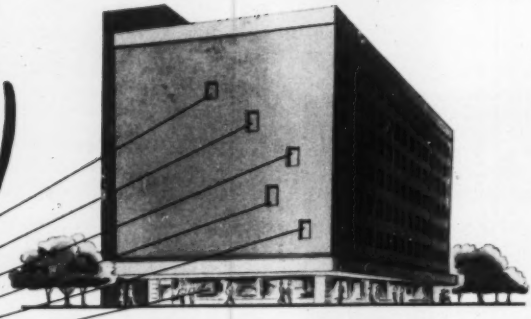
FRED H. SCHAUB ENGINEERING CO.

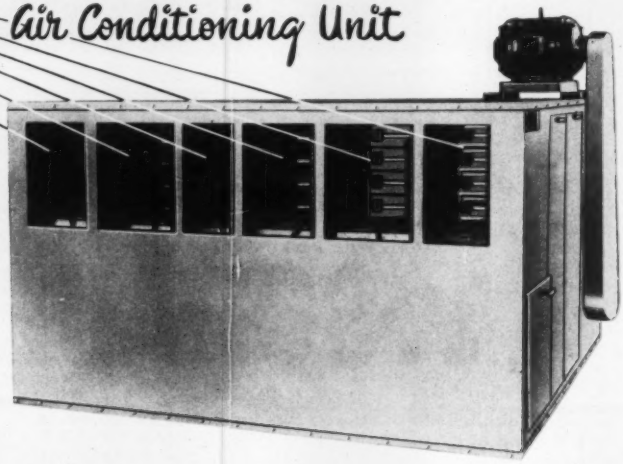
2116 S. Marshall Boulevard • Chicago 23, Illinois

NOW

Meet 6 Different Needs at One Time

with One Marlo MULTI-ZONE Air Conditioning Unit





Complete Winter and Summer Functions...Heating...Cooling... Filtering...Humidifying... Dehumidifying...Circulating and Recirculating

Where a variety of air conditioning demands must be met in a building simultaneously, new Marlo Multi-Zone Units offer these outstanding advantages:

- Each unit has its own thermostatically-controlled dampers to modulate and control the flow of warm or cold air for each zone outlet.
- Any air volume from 1500 CFM to 17,000 CFM can be proportioned to from two to six zones—for any combination of functions.
- Individual temperature control for *each zone*. (One zone can cool while another can heat).

MARLO • HEAT TRANSFER
Since 1923

Write for new Bulletin No. 409-MZ for information on the complete line of Marlo Multi-Zone Air Conditioning Units.

Marlo
MANUFACTURERS OF

COIL CO. • 6135 Manchester Rd. • St. Louis 10, Mo.

COOLING TOWERS • EVAPORATIVE CONDENSERS • INDUSTRIAL COOLERS
AIR CONDITIONING UNITS • MULTI-ZONE UNITS • BLAST HEATING & COOLING COILS

Here's a *Space-Saving* air distribution system

using
kno·draft
type HPC high pressure
air diffusers

Kaufmann's Department Store, Pittsburgh, Pa., uses 3,500 Kno-Draft HPC Air Diffusers. Units are installed 7 feet apart on 7″ x 14″ ducts, which are located 20 feet apart and mounted about 9 feet from the floor. In spite of the small, space-saving ductwork, thorough, draftless distribution of air is obtained.

Kno-Draft Type HPC High Pressure Air Diffusers are brand-new in principle, but already *proved* in service. Operating at high pressure and velocity, they provide draftless distribution of air to large open areas but require only small, uniform, exposed ducts. As developed for Kaufmann's Department Store in Pittsburgh, the Kno-Draft Type HPC High Pressure Air Diffuser—

1. **Saves** space; uses small, uniform exposed ducts.
2. **Operates** at high pressure and velocity —allows 3000 fpm velocities and 2″ static pressure in ducts.
3. **Achieves** high air induction, draftless distribution—primary air 25° colder than room air.
4. **Provides** complete adjustability to any volume between 90 and 180 cfm, or may be totally shut off.
5. **Functions** perfectly in department store and general office applications.

A new type perforated damper, combined with an interior baffle and jet exit, permits the high pressures and velocities necessary. For a detailed description of the new Kno-Draft Type HPC Air Diffuser—how it works and its application possibilities—mail the coupon today.

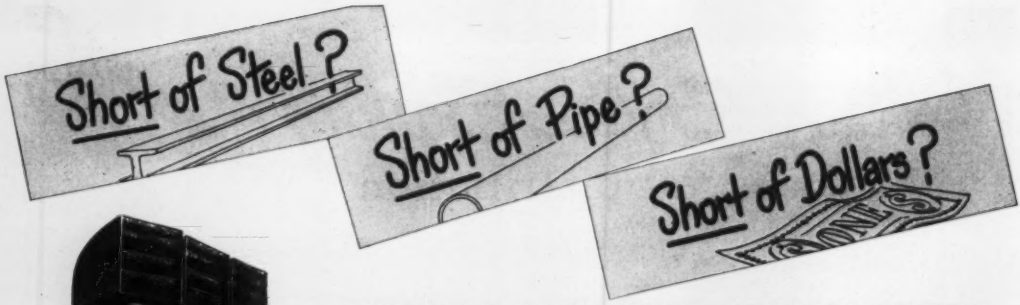
TRADE MARK "KNO-DRAFT" REG. U. S. PAT. OFF.

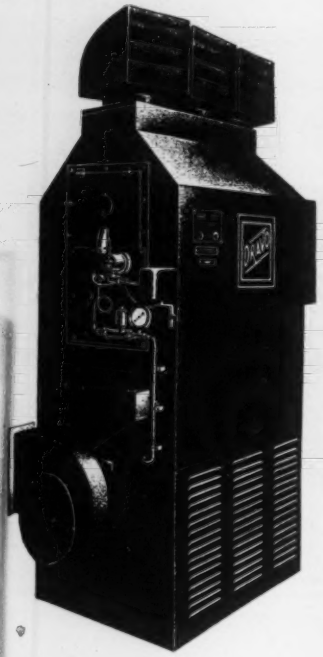
W. B. CONNOR ENGINEERING CORP.
Danbury, Connecticut
Air Diffusion • Air Purification • Air Recovery
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

W. B. CONNOR ENGINEERING CORP.
Dept. G-41, Danbury, Connecticut

Please send me, without obligation, Bulletin K-26, which provides full information on the NEW TYPE HPC Kno-Draft Air Diffuser.

Name .....
Position .....
Company .....
Street .....
City ..... **Zone** ..... **State** .....





DRAVO HEATERS SAVE STEEL,

MONEY—FUEL—and MAN HOURS

The steel needed for a heating system *can* be slashed from 50% to 70% for the representative open-space industrial structure shown below . . . by using the direct-fired warm air heating method with Dravo "Counterflo" Heaters! This conservation of steel, vitally important today, adds another saving to the long list of economies in money, fuel and labor effected by this heating method.

The chart below gives the detailed comparative story. Every system is equivalent in Btu output. Steel requirements for the 13 methods have been carefully and conservatively calculated.

You will see that Dravo Heaters not only take LESS steel in each fuel classification . . . but that the HIGHEST steel requirement in a Dravo installation is *almost 50% less* than the LOWEST steel requirement in *any other* system!

Look at the contrast in *pipe* required! Jobs now held up by slow pipe deliveries can MOVE . . . if Dravo heaters are used!

Dravo "Counterflo" Heaters can expedite installation jobs for you! And the steel and pipe savings are just two of the many reasons why more and more "Counterflo" Heaters are being used in all types of structures.

DRAVO HEATERS HAVE EARNED HIGHEST INDUSTRIAL ACCEPTANCE BECAUSE THEY OFFER—

- **LOW FIRST COST... Users report 50% to 60% savings**
- **WORKING-ZONE WARMTH . . . Units heat 4,000 to 20,000 sq. ft.**
- **NO FUEL WORRIES . . . Burn oil or gas . . . readily converted**
- **AUTOMATICALLY CONTROLLED . . . On-off or modulating controls**
- **LOW OPERATING COST...80-85% efficiency**
- **EASY INSTALLATION . . . Fuel, electric and exhaust connections only**
- **LONG LIFE—LOW MAINTENANCE . . . Stainless Steel combustion chamber**
- **TESTED—APPROVED . . . AGA and/or UL seal**
- **AVAILABLE...Immediate delivery, no delays**

Each heating system compared below was sized to make up a calculated 12,000,000 Btu heat loss in this representative industrial building.

WRITE TODAY FOR BULLETIN KL-526-2

TOTAL METAL REQUIREMENTS FOR VARIOUS HEATING SYSTEMS WITH IDENTICAL 12,000,000 Btu LOAD

COMPONENT	GAS FIRED					OIL FIRED					COAL FIRED		
	DRAVO WARM AIR	HIGH PRESSURE CONVENTIONAL WATER TUBE BOILER	HIGH PRESSURE PACKAGED STEAM GENERATOR	LOW PRESSURE CONVENTIONAL WATER TUBE BOILER	LOW PRESSURE PACKAGED STEAM GENERATOR	DRAVO WARM AIR	HIGH PRESSURE CONVENTIONAL WATER TUBE BOILER	HIGH PRESSURE PACKAGED STEAM GENERATOR	LOW PRESSURE CONVENTIONAL WATER TUBE BOILER	LOW PRESSURE PACKAGED STEAM GENERATOR	DRAVO WARM AIR	HIGH PRESSURE CONVENTIONAL WATER TUBE BOILER	LOW PRESSURE CONVENTIONAL WATER TUBE BOILER
BASIC HEAT GENERATORS	26,400	38,000	62,000	38,000	62,000	26,400	38,000	62,000	38,000	62,000	27,450	38,000	38,000
PIPING—Oil—Steam Boiler Room—Gas	9,096	15,490	15,490	35,308	35,308	4,352	15,790	15,790	35,608	35,608		14,990	34,808
TANKS—Oil—Blow-off Condensate		3,500	1,500	1,500	1,500	13,000	16,500	14,500	14,500	14,500		3,500	1,500
UNIT HEATERS Including Traps & Starters		21,240	21,240	21,240	21,240		21,240	21,240	21,240	21,240		21,240	21,240
STACKS & BREECHING	1,200	4,000	400	4,000	400	1,200	4,000	400	4,000	400	1,200	4,000	4,000
PUMPS—Fuel Oil Auxiliary Oil—Boiler Feed		1,000	1,000	1,000	1,000	400	1,400	1,000	1,400	1,000		1,000	1,000
STOKERS & FANS—including Dust Collectors Fuel Oil Preheaters							2,000		2,000		23,850	15,000	15,000
STRUCTURAL STEEL Boiler House Foundation Reinforcing		7,000	2,000	7,000			7,000	2,000	7,000			7,000	7,000
TONS of STEEL REQUIRED	DRAVO **18**	**45**	**52**	**54**	**61**	DRAVO **23**	**53**	**58**	**62**	**67**	DRAVO **26**	**52**	**61**

DRAVO CORPORATION

HEATING DEPARTMENT, DRAVO BUILDING, PITTSBURGH 22, PA.

Sales Representatives in Principal Cities

Manufactured and sold in Canada by Marine Industries, Ltd., Sorel, Quebec

Mr. M. Hochede, General Manager
New Mission Heating & Ventilating Co.
San Francisco, Calif.

"SUBSTANTIAL SAVINGS"

with

QC METALBESTOS

GAS VENT

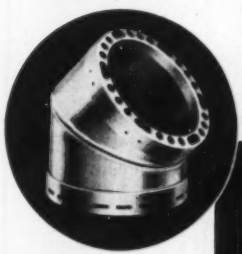
reported by San Francisco contractor.

Mr. M. Hochede, General Manager of the New Mission Heating & Ventilating Company, having recently completed work on a large housing project, has this to say about Metalbestos Gas Vent Pipe:

"When QC Metalbestos was first manufactured by the William Wallace Company, we could see that there would be a substantial saving in labor increasing our profits and enabling us to do more work with the same amount of men. As one of the most vital things in any business is labor, we were quick to adopt this new product."

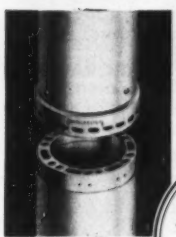
LOWER INSTALLATION COSTS were possible because lightweight self-aligning sections go quickly into place. No special tools or skills needed. Adjustable lengths and versatile fittings eliminate costly cutting and special fabrication . . . keep labor costs to a minimum.

Order from your jobber or write to Dept. N



Adjustable Elbows simplify installation.

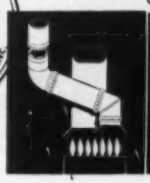
Adjustable Length eliminates cutting and fitting.



Quick Coupling speeds assembly.

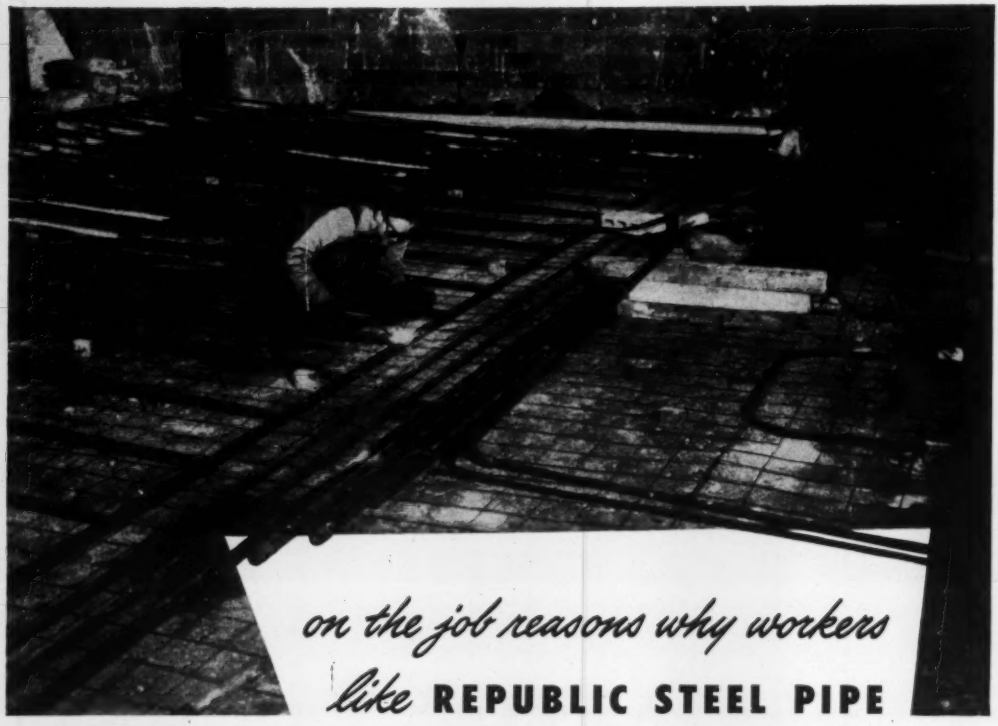
LISTED UNDER RE-EXAMINATION SERVICE
UL
OF UNDERWRITERS' LABORATORIES, INC.

Metalbestos Gas Vent pipe meets all safety requirements of the Underwriter's Laboratories for Type B Gas Vents.



METALBESTOS DIVISION

WILLIAM WALLACE COMPANY · BELMONT, CALIF.



on the job reasons why workers like **REPUBLIC STEEL PIPE FOR RADIANT HEATING**

Our Lady of Peace Catholic Church, Cleveland, Ohio. Sweeney and Wise Co., heating contractor. Stickle, Kelly and Stickle, architects.

● For many years, steel pipe has been standard for closed heating systems. It has done its job well, giving long, trouble-free service. Its record proves you need nothing more costly than Republic Steel Pipe for today's closed radiant heating systems.

Made by Republic's own advanced Continuous Weld Process, it is highly ductile, easy to fabricate, especially suited to close coiling and bending. It rates a warm welcome by the men who fabricate and install radiant panels.

For example, the men who worked on this big church heating job fabricated of Republic Steel Pipe like its easy bending.

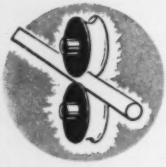
They like the way it takes a weld.

They have had no trouble with welds failing to hold.

They're not afraid of accidentially damaging this rugged pipe.

Why not check with your jobber now about Republic Steel Pipe for the radiant heating jobs you've lined up for later in the year? It's not a bit too early to let him know your future needs.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Dept.: Chrysler Bldg., New York 17, N.Y.



REPUBLIC CONTINUOUS WELD PIPE

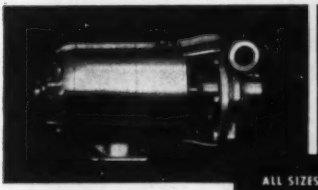
Uniformly Strong
Uniformly Ductile
Uniformly Clean and Scale Free
Easy to Weld by All Modern Methods
Easy to Bend, Thread and Close Coil
Economical Uniform Lengths, Extra Long Lengths
Uniform Wall Thickness, Diameter, Concentricity
Expansion Co-efficient Same as Concrete and Plaster

BIG OR SMALL — INDOORS OR OUT YOU CAN SAVE ON COST AND SERVICE WITH PEERLESS *FLUIDYNE* PUMPS

PEERLESS PUMPS

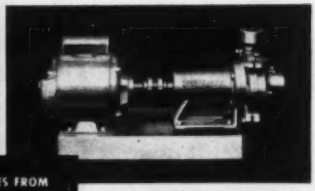
Type PB Pumps in service handling engine jacket cooling water.

Type PB Pumps providing water supply to pressure system.

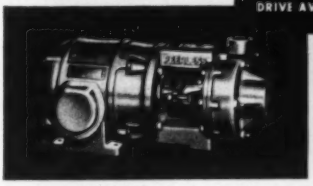


Fractional HP Close Coupled Electric Type PE Fluidyne Pump

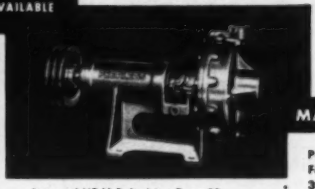
ALL SIZES FROM ¼ H. P. to 150 H. P. ALL TYPES OF DRIVE AVAILABLE



Fractional HP Flexible Coupled Type PB Fluidyne Pump



Integral HP Close Coupled Electric Type PE Fluidyne Pump



Integral HP V-Belt drive Type PB Fluidyne Pump

10 REASONS WHY THESE PEERLESS END SUCTION PUMPS OUTPERFORM IN GENERAL PURPOSE APPLICATIONS

1. **They're ECONOMICAL.** Designed with economy in first cost, installation, maintenance and operation — all without compromise of quality.
2. **They're DURABLE.** Every consideration has been given in design and construction to assure long service life even under abnormal service.
3. **They're EFFICIENT.** In all sizes, types and models the Fluidyne line is characterized by high performance ratings.
4. **They're VERSATILE.** Indoors or out, every general utility pumping service can use Peerless Fluidyne Pumps.
5. **They're COMPACT.** Space costs money; Fluidyne pumps fit neatly into both piping and pumping layouts as well as into subassemblies.
6. **They're EASILY MAINTAINED.** No special tools are required to perform ordinary pump maintenance in the Peerless line.
7. **They're DEPENDABLE.** Ample safety factors assure performance on continuous or intermittent duty, regardless of mounting angle.
8. **They're GOOD LOOKING.** Pleasing, trim and compact, their sturdy exterior design makes for neat installations.
9. **They're HYDRAULICALLY CORRECT.** Peerless impeller and volute design assure nonpulsating, non-turbulent liquid flow.
10. **THE LINE IS COMPLETE.** The Peerless Fluidyne line is one of the broadest offered by any manufacturer. Drives: electric, belt or flexible coupled; Hp range: from ¼ to 150 hp; Capacities: up to 5500 gpm; Heads: up to 260 ft. Write for descriptive bulletin today.

NEW BULLETIN

describes additional features of both fractional and integral hp pumps in the Peerless Fluidyne Line. Write for your copy of this 24-page fully illustrated and descriptive bulletin by mailing coupon today for Bulletin B-2300.

MAIL COUPON TODAY

Peerless Pump Division,
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, Calif.

Please send without obligation new Bulletin B-2300 describing Fluidyne line of fractional and integral hp pumps.

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

HPAC

PEERLESS PUMP DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

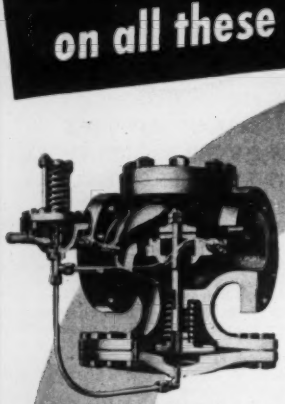
Address Inquiries to Factories at:
Los Angeles 31, California or Indianapolis 8, Indiana.
Offices: New York, Atlanta, Fresno, Los Angeles, Chicago, St. Louis, Phoenix; Dallas, Plainview, Lubbock, Texas; Albuquerque, New Mexico.

PEERLESS PUMPS fmc

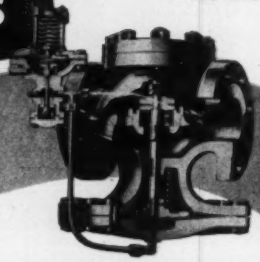
SAVE WITH SPENCE on all these jobs

Here are a few reasons why Spence Regulators give you accurate regulation and long, trouble-free life:

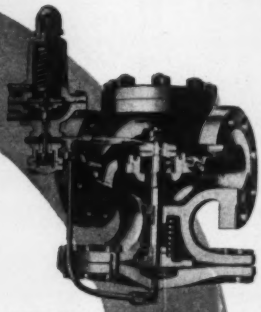
- **Single-seat Packless Construction**
- **Large Balanced Metal Diaphragm**
- **Sensitive Pilots**
- **SECO Metal Seats and Discs**
- **Springs out of path of steam**
- **No dismantling for inspection**



BACK PRESSURE CONTROL—Wide selection of sensitive pilots to meet exacting requirements. Initial pressure closing, guaranteed to shut tight. Packless construction, metal diaphragms.

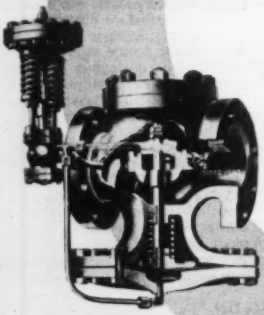


PRESSURE REDUCING—Self-operated, dead-end regulators powered by large, frictionless, metal diaphragms. Sizes ¼ in. to 12 in. Pressures to 600 psi 750 F.

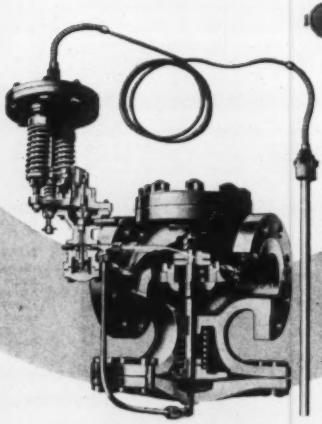


DIFFERENTIAL PRESSURE—Accurate control of delivery pressure at a constant, adjustable differential from 3 to 150 psi above another source of fluid pressure.

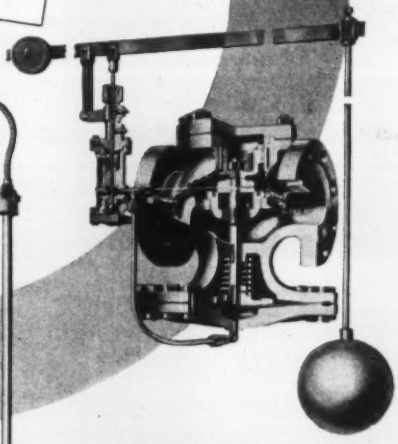
WRITE FOR BULLETIN 350
for complete details on Spence's line of automatic regulating valves



PUMP GOVERNOR—Constant or excess pressure control for steam pumps. Steam pressures to 600 psi 750 F, pump discharge pressures to 2000 psi.



TEMPERATURE REGULATING—Combined temperature and pressure control. No separate reducing valve required. Shuts tight, will not wiredraw or be damaged by overheating. Sizes to 12 in.

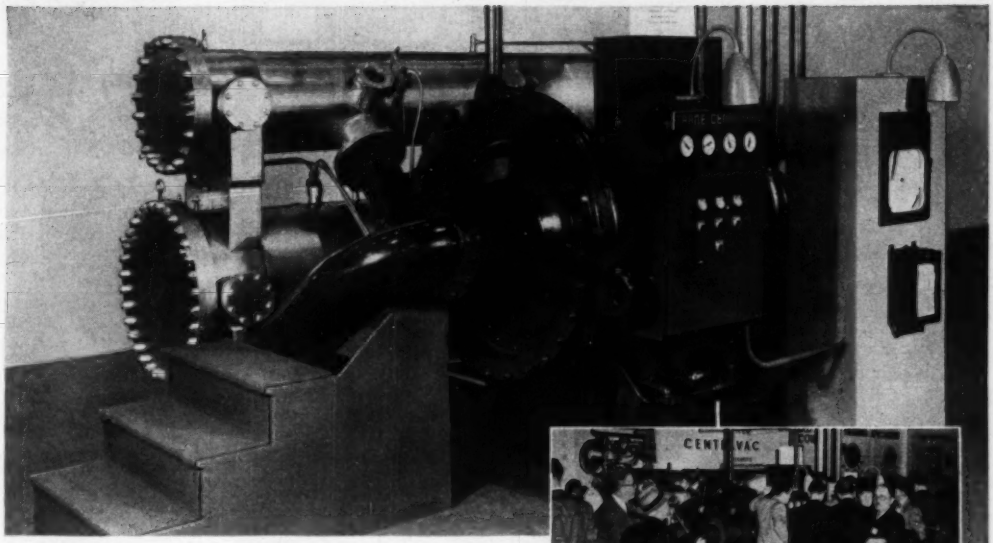


LEVER OPERATED—Pilot lever for connection by cable or mechanical linkage to floats or other devices. Slight actuator motion opens and closes main valve.

95-113

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence



The Trane CenTraVac display as seen by thousands at the 10th International Air Conditioning Exposition at Philadelphia in January, 1951. Operating throughout the show, the CenTraVac demonstration was the main attraction of the giant 173-foot Trane booth where a total of seven new Trane heating and air conditioning products, were on display.

TRANE CenTraVac...

The Hit of the Air Conditioning Show

So quiet and free from vibration is the CenTraVac that you can hardly tell it's running. So advanced is its design that a new wide range of applications is opened up for this economical and dependable type of refrigeration. No wonder the new Trane CenTraVac—hermetic, centrifugal refrigeration unit—was the hit of the Air Conditioning Show.

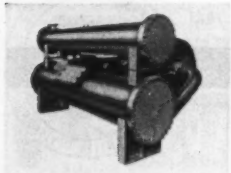
Now—for the first time—these outstanding advantages are available for jobs requiring as low as 45 tons of refrigeration: hermetically sealed, direct drive design... automatic capacity control from 100% down to 10%... reduced horsepower under reduced load operation.

Simplified Installation—Without complicated controls, piping or wiring, *one* compact, lightweight machine provides a complete source of chilled water for air conditioning and process cooling applications large or small.

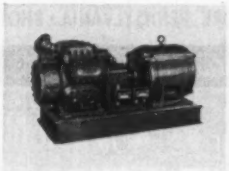
Low Operating Costs—CenTraVac built-in capacity control automatically adjusts the output of the unit to variations in demand of the cooling system. Horsepower per ton parallels capacity reduction over wide range of operating conditions making possible substantial savings in power consumption.

Save on Maintenance and Repair—Direct drive feature eliminates all but two main bearings in entire machine. Water cooled, hermetically sealed motor protected by failure-proof forced-feed lubrication. Nothing to go wrong, no unnecessary parts to wear out, no seasonal overhaul, no refrigerant loss when properly installed. Runs continuously season after season or can be easily shut down and started up as often as desired.

For full information on the new Trane CenTraVac, contact the nearest Trane field representative or write to The Trane Company, La Crosse, Wisconsin for Bulletin S-399.



The new Trane CenTraVac is a complete, self-contained water chilling unit. Shown here are the evaporator and condenser which are an integral part of the machine.



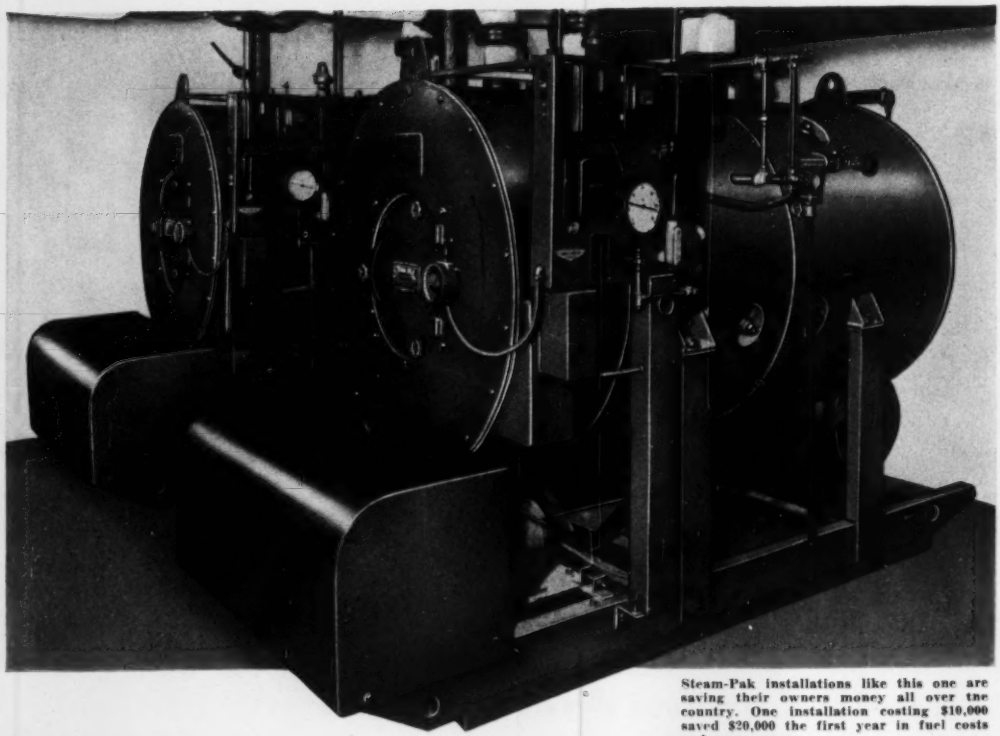
A brand new, all new line of Trane designed and Trane built reciprocating compressor and condensing units up to 50 tons was also introduced at the Philadelphia show.

Introduced for the first time—a new line of Trane Self-Contained Air Conditioners that occupy minimum space, and require minimum piping and electrical connections.

TRANE

MANUFACTURING ENGINEERS
OF HEATING, VENTILATING AND
AIR CONDITIONING EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division, Scranton, Pennsylvania
Trane Company of Canada, Ltd. . . . Toronto
OFFICES IN 80 U.S. and 10 CANADIAN CITIES



Steam-Pak installations like this one are saving their owners money all over the country. One installation costing $10,000 saved $20,000 the first year in fuel costs and manpower.

STEAM-PAK YORK POWER GENERATOR
A PRODUCT OF YORK-SHIPLEY

WILL SAVE YOU MORE IN TIME & MONEY BECAUSE...

- Engineering design is recognized by top engineers and architects who specify Steam-Pak for quality and results.
- Satisfactory operation in thousands of buildings and plants all over the country prove Steam-Pak's ability to satisfy customers.
- Distributors chosen for their engineering ability, are trained to provide you with the best engineering "know-how" for installation and service of your equipment.

These are three basic reasons why Steam-Pak should be No. 1 on your list of steam generators. See your nearest York Power distributor, or write for complete details.

Steam-Pak Generators are built in capacities from 15 H.P. up, for low or high pressure, steam or hot water, for light or heavy oil, combination gas and oil, or straight gas.

334 JESSOP PLACE · YORK, PENNSYLVANIA · PHONE 7861

YORK SHIPLEY *Industrial Division*

INDUSTRIAL DIVISION YORK POWER — YORK HEAT RESIDENTIAL DIVISION

Steam-Pak Generators · Vertical Boilers · Rotary Oil Burners · Conversion Oil Burners · Conversion Gas Burners · Water Heaters · Winter Air Conditioners · Tubeless Boiler Units

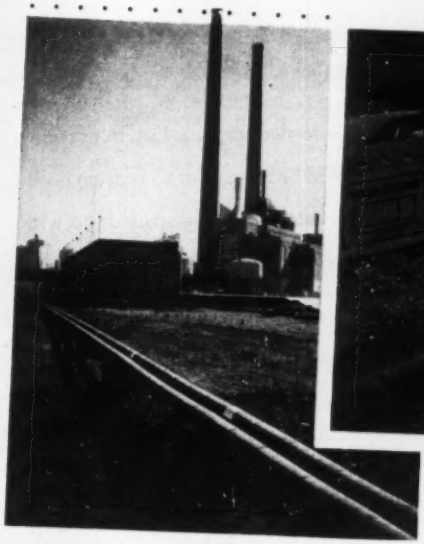
THE BEST GLASS INSULATION IS CELLULAR GLASS . . .

the only cellular glass insulation is PC Foamglas

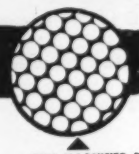
You can install PC Foamglas Insulation in walls and floors, roofs and ceilings — on hot and cold piping, indoors and outdoors—for heating, cooling and processing systems—on tanks, ducts and other air handling equipment—with full confidence that you will find its efficient, long-lasting, trouble-free service completely satisfactory.

The only material of its kind, PC Foamglas is an exceptionally effective insulation. In addition, Foamglas lasts so long that on a "cost-per-year" basis it becomes the "cheapest" insulating material. For Foamglas, when properly installed, retains its original insulating effectiveness—without costly repairs, maintenance or replacement.

When next you figure on insulation, consider the advantages you get with Foamglas. If you are facing special insulating problems, our specialists will be glad to consult with you. Meanwhile, send in the convenient coupon and our booklets will be forwarded promptly, with a sample of PC Foamglas.



PC FOAMGLAS Pipe and Fitting Insulation on these hot oil feed and return lines of the Steam Electric Station of Dallas Power and Light Company, Dallas, Texas, helps maintain operating temperatures of 400°F. and 200°F. respectively. **Insulation Contractor:** Thermal Products Company, Houston, Texas.



THIS MAGNIFIED DIAGRAM SHOWS that PC Foamglas is composed almost entirely of still air, which is sealed in minute glass cells. The black areas indicate glass, the white areas air. The insulating properties of still air and the unusual resistance of glass to moisture, chemicals and other elements that cause insulation to deteriorate, make Foamglas an exceptionally effective, long lasting insulating material.

Pittsburgh Corning Corporation
Dept. AF-41, 307 Fourth Avenue
Pittsburgh 22, Pa.

Without obligation on my part, please send me your FREE booklets on PC Foamglas insulation for:

Piping & Equipment ☐ Refrigerated Structures ☐
Commercial & Industrial Buildings ☐

Name.....

Address.....

City.....State.....

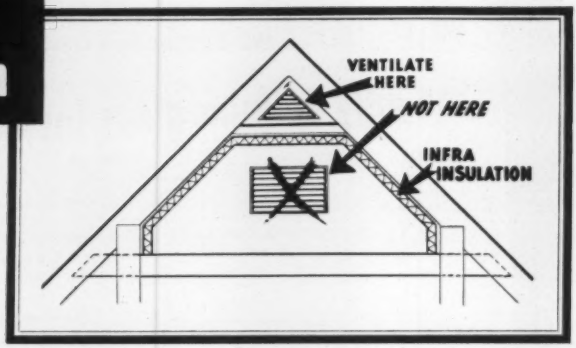
PITTSBURGH ® PC CORNING

FOAMGLAS cellular glass INSULATION

. . . when you insulate with FOAMGLAS . . . the insulation lasts!

Don't Vent Below Insulation

Vents below insulation let heated air out, cold air in, waste fuel in winter. This defeats the purpose of insulation, which is to prevent the escape of heat.



Ventilation is generally necessary above all insulations, less in residences, more in buildings where crowds or other conditions create large amounts of water vapor. Where roof rafters are insulated, it is good practice to cap under the ridge, insulate across, and ventilate above.

With ordinary insulation, at least 1 sq. in. of free opening is needed for each 4 sq. ft. of ceiling and wall surface exposed to vapor flow. No point in the vented space should be more than 25 ft. from a vent opening. Adequate ventilation takes care of vapor which seeps through into a building space from within, and of evaporated water which leaks in through nail holes and other openings from without. In summer, attic vents help lessen the heat load imposed by the sun.

Multiple accordion aluminum is non-condensation forming, non-absorbent. Since it is impermeable to vapor, it will slowly force out, even without vents, ordinary amounts of fortuitous vapor which has leaked in through openings in the outside walls. (To do this, an insulation must have a permeability no greater than one-fifth that of the colder outer wall or roof.) Venting accelerates this process.

Multiple accordion aluminum turns back 97% of the infra-red rays striking it; emits from its opposite surface but 3%. There is negligible conduction, and convection is blocked. The commercial form of multiple accordion aluminum, with 6 integral reflective spaces and 6 reflective surfaces is Infra Insulation Type 6.

THERMAL FACTORS, TYPE 6 INFRA
Down-Heat C.044, R22.72 equals 7½" DRY Rockwool
Up-Heat C.080, R12.50 equals 4" DRY Rockwool
Wall-Heat C.073, R13.69 equals 4½" DRY Rockwool
VAPOR PERMEABILITY equals ZERO

INFRA INSULATION, INC.
10 Murray Street New York, N. Y.
Telephone: COrtlandt 7-3833

INFRA INSULATION, INC.
10 Murray Street, New York, N. Y. Dept. H4

Please send "Simplified Physics of Vapor and Thermal Insulation."

Name_____

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☐ Send Prices of Infra Insulations ☐ Send Sample

THE EDITOR'S PAGES

• OPERATING PROBLEMS of a small hospital in the South and a big industrial plant in the East differ greatly in many ways, but when it comes to an essential service like heating these problems may very often be identical. The point was brought rather strikingly to our attention not so long ago when we got into conversation with the plant engineer for a well-known and important manufacturer. To start the ball rolling, we asked him what plant problem was of most concern to him right at that moment, and it turned out to be a matter of uneven heating due to the use of both convector radiation and direct radiation on the same system. We were happy to be able to tell him that the same situation was also the immediate problem faced by the maintenance manager of a hospital, who had asked us for informed comment on what to do about it, and that we had some suggestions to offer . . . . We mention it here to remind you not to miss reading regularly the Question of the Month feature each month in HPAC. In this department—and in other features and articles appearing in HPAC—we know you'll find many an idea used in some other part of the country (and perhaps in a totally different type of plant or building) which can be of help to you in your own heating, piping and air conditioning work.

CONTRACTOR CELEBRATES 75TH ANNIVERSARY

SAUER, INC., mechanical contractor for heating,ventilating, air conditioning, process piping, plumbing, snow melting, boiler plants, etc., of Pittsburgh, Pa., and Columbus, Ohio, is celebrating its 75th anniversary this year. This company, under the direction of William N. Steitz, President, and James L. Coleman, Jr., Vice President and Secretary, has done the heating, ventilating and plumbing in many of Pittsburgh's large buildings—Koppers building, United Engineering and Foundry office building, Federal Reserve bank, Bell Telephone building, and the Grant building. Among recent Sauer contracts are the Mellon-United States Steel building, the Pennsylvania Railroad freight terminal and the Alcoa building.

An attractive 40 page brochure tells the story of the firm, one of the oldest American organizations in the field of mechanical contracting. Copies of the booklet are available to HPAC's readers on request to Sauer, Inc., 2701 East St., Pittsburgh, Pa.

REFRIGERATION SAFETY "PAYS ALL WAYS"

APRIL HAS BEEN designated as National Refrigeration Safety Month, and the slogan for the occasion is "Safety in refrigeration pays all-ways every month in the year." Twelve refrigeration and allied associations are cooperating with the National Safety Council in the affair.

By a thorough safety program in one state, the accident frequency rate has been reduced to below half that common to the industry, with a consequent 50 percent reduction in the workmen's compensation insurance premium rate, according to R. H. Israel, who is president of the Refrigeration Equipment Manufacturers Association.

RADIANT HEATING PREVENTS CONDENSATION ON FLOOR

A SOUTHERN sugar refiner has solved what was literally a sticky problem, through the use of radiant heating.

Officials of this modern cane sugar refinery had been plagued for a long time by the presence of moisture on the floors of their raw sugar warehouses at a deep water port where relative humidities range quite high. These floors consisted of concrete covered with ¼ in. steel plates. Cold weather "sweating", particularly after a warm humid night, created a hazard because of the inevitable spilling of sugar, the small particles adhering and making the area dangerous to work in.

Engineers decided the job couldn't be tackled by halfhearted measures. They ripped up the old floor, installed radiant heating coils of 1 in. wrought iron pipe, and laid a new floor over them. The system was extended also to cover all runways from the wharf to the manufacturing area.

The installation, which is regulated to keep the floor slab at a temperature 5 to 8 deg warmer than that outside, has eliminated condensation moisture. Recently, the entire refined sugar shipping department got a similar treatment which includes all storage and operational areas as well as shipping platforms.

"QUOTE"

"Ineptitude in getting along with people, and being a poor 'team player', are more common deterrents to engineering success than is lack of engineering skill.

"Almost never, in industry, is a graduate of a recognized engineering college or technical school found unsatisfactory in his knowledge of the fundamentals which he is expected to know. Shortcomings are almost always related to the 'human side' of engineering."—*J. R. Vernon, Secretary and Sales Promotion Manager, Johnson Service Co., in a talk before several groups of college engineering students.*

ASTM ATMOSPHERIC COMMITTEE ORGANIZES

A NEW TECHNICAL committee which is to concentrate on the formulation of methods of atmospheric sampling and analysis, the selection of acceptable nomenclature and definitions and the stimulation of research to accomplish the foregoing purposes, held its organization meeting recently at the headquarters of the American Society for Testing Materials, 1916 Race St., Philadelphia 3. Dr. L. C. McCabe, Chief, Air and Stream Pollution, U. S. Bureau of Mines, chairman of the new committee, which has the designation D-22, presided.

Subjects which the committee is expected to consider include both integrated and instantaneous sampling procedures, methods of analysis

for aerosols and gases, and smoke density determination. Clarification of terminology of measurement units will certainly be on the docket.

MILITARY CONSTRUCTION TOTALS $2.4 BILLION

ALTHOUGH THE FULL scope of the military construction program cannot at this time be forecast accurately, currently the work authorized through the fiscal year 1951 — and for which funds have been made available for both Army and Air Force construction — total $2.4 billion, Major General Lewis A. Pick, Chief of Engineers, Department of the Army, told the Associated General Contractors of America in Boston.

Addressing the group's 32nd annual convention, General Pick said the anticipated increase in the workload has trebled in recent months. He expressed confidence that the Corps of Engineers would be capable of meeting "any job which lies ahead."

Front Cover Photo

AERONAUTICAL RESEARCH facilities are being increased at the Lewis Flight Propulsion Laboratory in Cleveland by a $40 million project featuring a new supersonic wind tunnel which will be the largest and most powerful in the world.

Operated by the National Advisory Committee for Aeronautics, the laboratory is concerned principally with problems of flight propulsion, including supersonic aerodynamic problems. To learn answers to the many jet engine problems still unsolved, it is necessary to isolate the problems and study them under precisely controlled conditions.

The basic research tool is air . . . enormous quantities of it and at temperatures from —108 F to 90 F. Despite the fact that supplies of mechanically cooled air have been greatly increased, it is still necessary to "ration" the cold air. This is accomplished in a centralized control room where the operator regulates both quantities and temperatures sent to more than 100 test units in the laboratory. To insure that the right amounts of cold air (it is measured in lb per sec) go to test setups having the highest priorities, the total available supply is budgeted from week to week and day to day, around the clock.

Temperatures, pressures and quantities of air for over 100 test setups are controlled in the room shown on our cover. (Photo courtesy Carrier Corp. and NACA.)

GAS SALES HIT ALL-TIME HIGH

UTILITY SALES OF GAS to ultimate consumers reached an all-time high level of 4654 million therms in December 1950, an increase of 24.4 percent over the 1949 figure, the American Gas Association has reported. The AGA's index of gas sales on December 31, 1950, stood at 318.4 percent of the 1935-1939 average.

For the 12 months ended December 31, 1950, utility sales of gas aggregated 41,943 million therms, an increase of 17.6 percent over sales in the previous corresponding cumulative period in 1949.

REPORTS CONSTRUCTION CONTRACT AWARDS

CONSTRUCTION CONTRACT awards for January 1951 in the 37 states east of the Rockies were down 11 percent from December but were still high enough to be 43 percent ahead of January 1950, it has been reported by the F. W. Dodge Corp. The figure was $1,043,248,000.

Residential awards were down 12 percent from the December figure, but were 23 percent ahead of January 1950. Non-residential contracts were 6 percent below December, but 96 percent above January last year.

GIVES COST OF SNOW MELTING JOB

IN ANSWER to an employee's question published in the company's magazine "Synchroscope", Walker Cisler, Executive Vice President of The Detroit Edison Co., gave last month some cost figures on sidewalk snow melting systems.

A few of the company's steam customers are pumping hot water through pipes in their sidewalks to keep the walks warm during snowstorms. These cost about $5 to $6 per sq ft of sidewalk for the complete installation—including heaters, pumps and controls—and about 3½ cents to 4½ cents per sq ft per season for the steam used to heat the circulating water, Mr. Cisler said.

For an electrical snow melting system, the installation cost is approximately $2.50 to $3.50 per sq ft to provide "only the minimum heating requirements", he said. Taking one of the company's sales offices as a specific example, an expenditure of $9000 would be required for the public walks around this building and the power required would be 150 kv, he stated.

'51 BACKLOG 50 PERCENT UP

THE H. K. FERGUSON CO., industrial engineers and builders, entered 1951 with a backlog more than 50 percent greater than the previous year, according to an announcement last month.

The management did not disclose actual volume figures, but it was announced that 1950 was the third best year in the company's 32 yr history from a sales standpoint. The amount of new business developed was approximately two-thirds of that developed in 1946, the largest year. New business in 1950 tripled the volume sold in 1949.

TERRIFIC GROWTH IN FUEL DEMAND

ONE OF THE phenomena of our burgeoning economy in the United States since World War I has been the terriffic growth in demand for energy for both heat and power, according to Robert E. Wilson, Chairman of the Board, Standard Oil Co. (Indiana), at the Northwestern University centennial conference on science, technology and world resources, at Evanston, Ill., last month. In spite of the fact that the heat requirement per average home was far larger in 1918 than now (because of larger homes, poorer insulation and few apartments), the total Btu demand for oil, coal and natural gas increased by 63 percent between 1918 and 1950.

The most striking thing, however, is that *all* of this growth of demand — and more — was supplied by oil and natural gas, as the output of coal actually declined slightly, he said. To meet the growth, our oil output has increased by 492 percent and our natural gas by 796 percent in that 32 yr period.

Hotel Vendome, Evansville, Indiana. Architect: Clifford Shopbell, for the original hotel; Fowler & Kargeo, for the new addition. Heating Contractor: H. G. Newman Plumbing Company.

44 years young

A story of sound heating system operation

In 1907, when the population of Evansville, Indiana, was 69,000, a modest 5-story hotel was built.

"Give us a heating system that will stand the test of time", the owners of the new Hotel Vendome told the H. G. Newman Plumbing Co., of Evansville. And so it was that the complete mechanical plant — from the high-pressure boilers to the Webster Vacuum Steam Heating System —was planned for long service life.

Five floors were added to the Hotel in 1913 . . . a 5-story annex was built in 1927—and both times there was an extension of the Webster Heating System.

In 1950, when Evansville had grown to 130,000, the Hotel Vendome undertook a complete renovation, including modernization of their mechanical plant. Once again they called on the H. G. Newman Plumbing Company. And once again they selected Webster Steam Heating Equipment.

Webster Radiator Traps and Valves, Drip Traps and other steam specialties are smaller, more compact than they were in 1907. Their efficiency and long service life have been even further improved.

Charles J. Scholz, president, Hotel Vendome, Inc., and his sons, Norman F., and Frederick J., vice-presidents, are convinced that modern heating pays for itself—in satisfied guests and lower operating costs.

For the last 42 years, Webster Service to the Hotel Vendome, their architects and contractors, has been provided by the organization of S. E. Fenstermaker, Indianapolis, one of the Webster family of long-service Representatives . . . the kind of service that is more important than ever today.

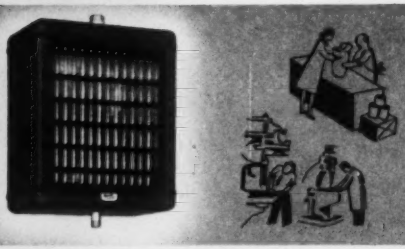
Address Dept. HP-4

WARREN WEBSTER & CO.

Camden 5, New Jersey : : Reps. in Principal Cities
In Canada, Darling Brothers, Limited, Montreal

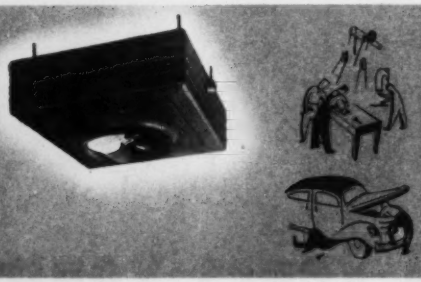
Webster HEATING

HEAT – as, when, and where you want it



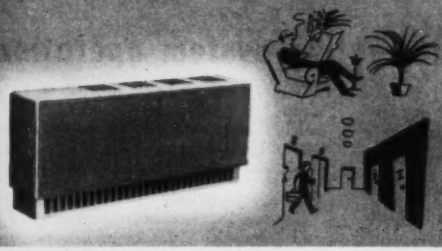
For Stores, Shops, Factories . . .
PROPELLER FAN UNIT HEATERS

Standard Webster-Nesbitt suspended unit heaters for quiet, economical working-zone comfort with easy controllability. Rugged, compact, efficient, incorporating standard or low-temperature non-ferrous heating elements of extended fin-and-tube type. Nine basic models in capacities from 34,700 to 338,000 B.t.u. Publication WN-126.



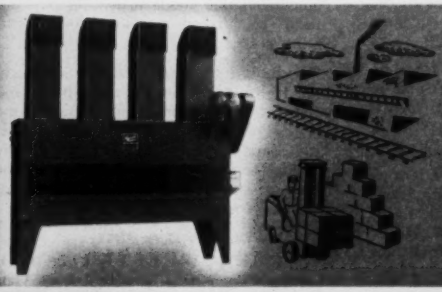
For Factories, Garages, Doorways . . .
LITTLE GIANT UNIT HEATERS

Downblow propeller fan units with blower fan performance, combining wide selectivity and versatility. Seven basic sizes: four larger draw-through models discharge a high-velocity vertical or horizontal downblow; three smaller blow-through models discharge vertically downward from lower mounting heights. Non-ferrous standard or low-temperature heating elements. Capacities from 23,900 to 348,000 B.t.u. Publication WN-134



For Vestibules, Lobbies, Corridors . . .
SERIES R UNIT HEATERS

Attractive, widely flexible cabinet units with low-speed belt-driven centrifugal fans and non-ferrous heating elements. May be installed as a vertical or horizontal floor, wall, or inverted-type unit, where appearance and concentrated heat are essential. Four unit sizes: 2, 3, 4 or 5 fans. Steam heating capacities from 158 to 588 e.d.r.; air deliveries, 518 to 1890 c.f.m. Publication WN-133.



For Factories, Warehouses, Hangers . . . GIANT UNIT HEATERS

Blower-type Giants for handling large quantities of air at relatively low final temperatures. Available in nine sizes for floor, wall, and ceiling mounting. Three types of control: Standard (motor control), Thermadjust (by-pass control), Valve Control. Capacities range from 2550 to 18,100 c.f.m. at final temperature, and 101,000 to 1,008,000 B.t.u. per hour. Publication WN-128.

Contact your Nearest Warren Webster & Co. Representative

Made by **JOHN J. NESBITT, INC., PHILA. 36, PA.**
Sold by **WARREN WEBSTER & CO., CAMDEN, N. J.**

Webster Nesbitt
UNIT HEATERS

• DO YOU HAVE something you'd like to say about any of the articles published this month? An additional comment, or perhaps a question on some point? Or do you want to express your views on some other matter of interest to plant engineers, building engineers, heating, piping and air conditioning engineers or contractors? We follow here each month the practice at engineering society meetings of providing an "open for discussion" period. You are most welcome to participate. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

BURNING WOOD WASTE AS A FUEL

WE HAVE READ with interest Samuel R. Lewis' recent comments on the burning of wood, and having had considerable experience in this field during the past decade, we believe that our discussion as outlined below will prove of interest.

Wood — in common with all fuels — requires a definite amount of air or oxygen for its complete combustion, and we have found that the long flame and delayed combustion mentioned by Mr. Lewis are the result of improper fuel-air ratio or improper mixing of the air and fuel because of incorrect furnace design and fuel admission rather than any inherent characteristic of the wood fuel.

When burned in a conventional dutch oven furnace on a brick hearth or on a flat grate, air admission and combustion are confined almost entirely to the outside of the pile and at a very high unit rate. The dutch oven is generally too small to permit complete combustion, so that much unburned combustible gas escapes to the boiler where it may continue to burn clear through to the stack (as Mr. Lewis notes) through lack of adequate secondary air and turbulence.

We have seen sander dust being burned with less than half the required air, with dense smoke pouring from the stack, become a smokeless fuel as soon as adequate air and turbulence were provided.

We have found that by spreading the wood fuel in a thin, even layer on a high resistance type flat grate, preferably installed in the furnace directly under the boiler, and using forced draft with most of the air through the grate, the flame length is greatly reduced — especially when adequate furnace turbulence is secured by means of overfire steam or air jets so that combustion is completed before the gases enter the boiler.

When firing wet, hogged fuel such as bark, wood, shavings and sawdust, we use a mechanical distributor to spread it onto the grate, which may be of the dumping or continuous discharge type. Correct design makes this mechanism practically trouble-free and power consumption is low. When dry sawdust, sander dust and shavings are the principal fuel, steam or air jets may be employed depending on furnace dimensions and fuel consist.

As Mr. Lewis notes, much of the fuel burns entirely or completes its combustion on the grate even when kiln dried. This is readily understood by any one familiar with pulverized coal firing, where to prevent large ashpit and cinder losses, the fuel must be crushed so that the majority will pass a 200 mesh screen — which is much finer than most sawdust.

When it comes to storing, conveying and feeding the various wood fuels, equipment far different from that used for coal must be used, as Mr. Lewis indicates. All hoppers must taper outwards at the bottom, and so-called live bottoms are essential. Because of the bulk of the wood compared with coal, all the above equipment must be considerably larger for equivalent outputs. Feeders of the screw, chain, rotary and belt types have been developed and we have acquired enough information to be able to design a satisfactory feeder for the fuel involved.

Combination fuels such as wood and oil may be fired in the same furnace when provision is made for the required air supply and furnace volume for each fuel.—H. G. MEISSNER, Stoker Engineering Dept., Combustion Engineering — Superheater, Inc.

SUSPENSION, SUPPORT OF PIPING

GEORGE W. HAUCK'S article in the March HPAC, Use of Welding to Facilitate Piping Suspension and Support, should have the hearty endorsement of all who have the responsibility of the proper installation of modern piping systems.

Special emphasis should be given to that portion advocating that "adequate suspension or support *should be part and parcel of the piping design*, and not left to the chance that satisfactory solutions can be improvised in the field during erection."

When alloys are involved, the welding of attachments to the piping material should be accomplished previous to the full furnace stress relief.—ERIC A. KERBEY, Executive Vice President, Midwest Piping & Supply Co., Inc.

SIZING PIPING FOR ANTIFREEZE SOLUTIONS

WE FEEL THAT the question raised by T. Napier Adlam, in his comments on page 74 of the December HPAC in his discussion of our article on How to Size Piping for Antifreeze Solutions, about the relations used to compute friction loss, should be further amplified for the sake of clarity. The use of the rational equation employing a friction factor f based on the Reynolds number of the flow, and the relative roughness of the conduit, is without doubt the most acceptable relationship for computing friction loss in pipes. This equation and necessary friction factor-Reynolds number diagram can be found in any text or handbook on the subject. Our data,

presented in tabular form, were intended to facilitate computation by this method. Absolute viscosities are given in English units, since it is generally most convenient to express pipe sizes and flow velocities in the same units. Should cgs units be desired it is only necessary to multiply the tabulated values by the dimensional constant 47,800 × (centipoise/lb-sec per sq ft).

With regard to Mr. Adlam's questions regarding the validity of formulas for viscosities expressed in English units or cgs units, we might add that as long as dimensional homogeneity is maintained, either set of units will serve equally well.

It was felt, however, that in order to simplify the computation process for the many practicing engineers who prefer to use head loss tables for design purposes, the graphical data presentation would be most convenient. Admittedly, to so simplify the computation does require a sacrifice of precision, but still yields results within engineering accuracy. It should be noted here that many of the head loss tables are based on empirical equations such as the Hazen Williams formula, and as Mr. Adlam points out, the limits of accuracy of these tabulated results in general fall in the same range as the accuracy of a linearized friction factor-Reynolds number curve for smooth pipe.

The Blasius equation for friction factor for smooth pipes, $f = (0.3164/Re^{0.25})$, is linear on a log plot and of slope —0.25 as pointed out by Mr. Adlam. This equation approximates the generally accepted Karman-Prandtl smooth pipe friction factor-Reynolds number relations quite closely in the range $2000 < Re < 10^5$ but diverges considerably at Reynolds number values above this upper limit. The least square fitted best line in the range $2000 < Re < 10^7$ has the slope —0.215. It should be noted that the friction factor-Reynolds number relationships for rough pipes decrease in slope as roughness increases and ultimately become horizontal (independent of Re) at higher values of Re. We therefore felt justified in using a slope of —0.20, since this represents a reasonable value for both smooth and rough pipes in the Reynolds number range usually encountered in practical pipe designs.

We appreciated Mr. Adlam's interest as evidenced by his discussion and hope that this amplification will clarify the points raised.—W. P. Armstrong, Assistant Professor of Chemical Engineering, and C. J. Kippenhan, Assistant Professor of Mechanical Engineering, Washington University.

USING RADIANT HEATING WITH HARDWOOD FLOORS

I was quite perturbed the other day when reading an article in HPAC answering a question about wood floors and radiant heat. The tenor of the answer seemed to be that radiant floor heating should not be used with wood floors.

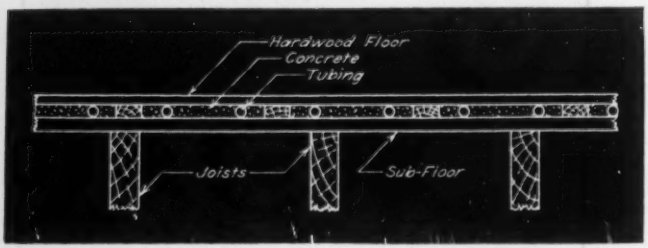
In my experience, such an installation is made quite simply by placing wood sleepers over the sub-floor, laying copper tubing between the sleepers (about 25/32 in. thick) and filling over the tubes with a poor grade of concrete, after which the hardwood flooring is laid. I personally designed and supervised the installation of such a system, and it works perfectly with 125 F water in a climate that reaches 35 F below zero every winter.

In an installation of this kind, the heat emissivity is raised from that of the copper to that for rough concrete, and the concrete acts as a grid, spreading the heat out uniformly over the floor.

The particular installation I designed and supervised was a one story structure with full basement. The floor was constructed of wood floor joists with a rough sub-floor laid on top. The copper tubing was laid out on the desired center to center distance on the sub-floor and fastened down. Next, furring strips were laid between the tubes in sufficient quantity to nail the hardwood floor. A poor grade of concrete was poured over the tubes between the furring strips and leveled off with the top of the furring strips. As soon as the concrete was dry and set, the hardwood floor was laid. Since the layer of concrete was thin, the additional cost and weight was negligible.

The same panels also heat the basement. The amount of heat allowed downward was controlled by insulation.—LeRoy Horpedahl, Mechanical Engineering Dept., North Dakota Agricultural College.

TYPICAL CONSTRUCTION for hardwood floor with radiant heating, as used successfully by Mr. Horpedahl



REGULATING WATER USE FOR AIR CONDITIONING

John R. Quinzio, in a comment published in the March HPAC, suggests that the "model ordinance" for regulating the installation and operation of air conditioning and refrigerating equipment as developed by the American Water Works Association should require the submission of plans prepared by a registered engineer, who should also make application for the permit to install, and that the permit should be made out in the owner's rather than the plumber's name.

For many years, municipal practice involving water works installations on the consumer's property has involved the installing plumber as the person required to obtain the permit to make the connections to the public water supply system and to conform to the regulations made on the one hand by the water department or company and on the other hand by the municipality insofar as the municipality has issued regulations relating to plumbing installations.

Reference to the plumber's liability for obtaining the permit is thus natural conformance to an established practice in the water supply field.—Harry E. Jordan, Secretary, American Water Works Association.

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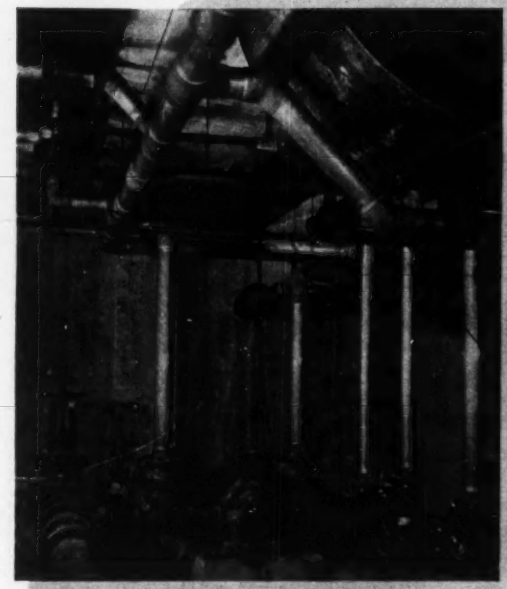

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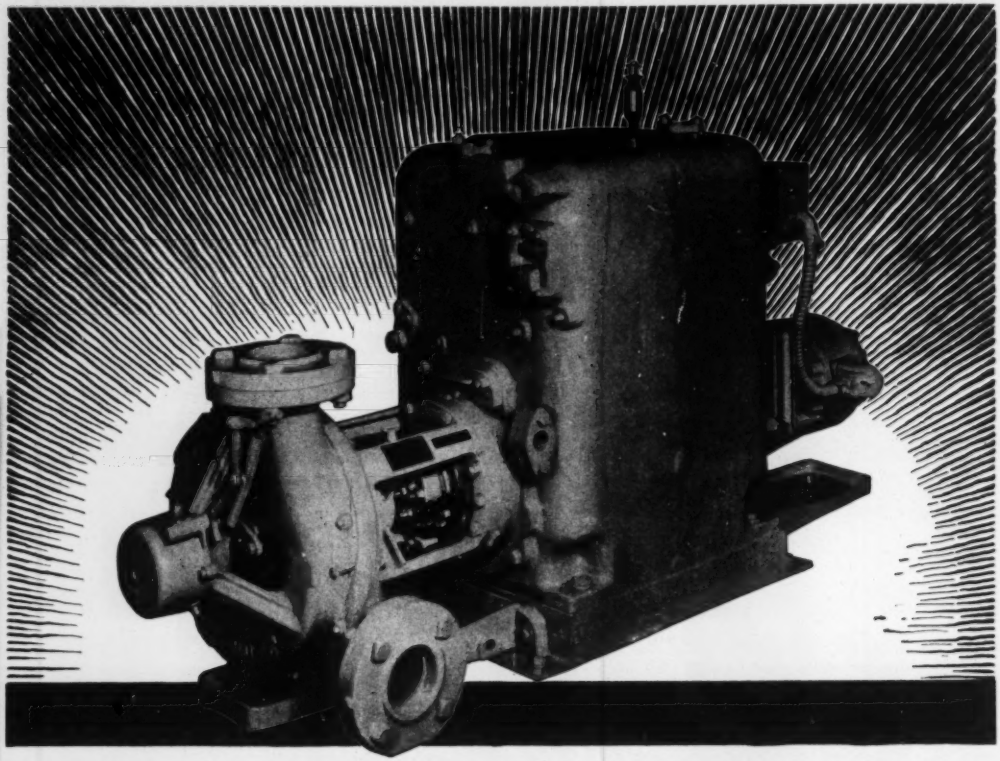

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THE NASH ENGINEERING COMPANY

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New Building at Mayo Clinic Completely Air Conditioned

By William Sturm
Chief Mechanical Engineer
Ellerbe and Co., Architects and Engineers

THE NEW DIAGNOSTIC building for the Mayo Clinic, now under construction in Rochester, Minn., will be completely year 'round air conditioned.

The new building — across the street to the west of the existing Mayo Clinic building — will be 10 stories above grade, plus basement and partial sub-basement and an equipment penthouse on the 11th floor. The structural framework is designed for eight future stories.

Each level, with the exception of the sub-basement, will have approximately 49,000 sq ft of floor area, as well as a partial mezzanine area of some 20,700 sq ft between the 1st and 2nd floors. The total floor area is 560,000 sq ft for the present, 952,000 sq ft for the future.

The total air conditioning load for the present 10 story section amounts (in round figures) to 1700 tons of refrigeration. The building has a cross plan designed as an efficient arrangement for diagnostic clinic procedures. This floor plan is typical for the 4th to 10th floors, inclusive.

Air Conditioning Allows Efficient Building Plan

The basic function of the clinic depends upon numerous small examination rooms, making the building essentially a multi-room, multi-story building. This feature established the main volume of the building to be air conditioned by the unit type system. Slightly more than half of the examination rooms are interior rooms.

The floor plan as designed — resulting as it does in many interior rooms — was possible only because the building will be air conditioned, permitting the interior spaces to be maintained at comfort conditions identical to the exterior spaces having windows. Also, the large main waiting rooms on the typical floors are without any exterior exposures.

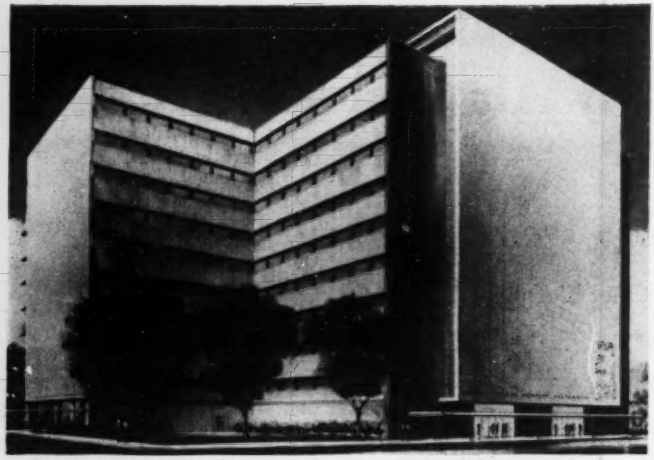
The above point is of considerable interest from the standpoint of architectural planning, in that the floor plan for the 1928 Clinic building is "H" shaped and every examination room as well as the waiting room has an exterior exposure with operating windows. The ability to air condition the new structure allows a more economical use of the available property as well as a more efficient plan for clinical procedure.

The building construction comprises a combination of insulated aluminum panels and marble facings employing light weight insulation back-up tile. The wall k factor is approximately 0.2 Btu per sq ft per deg.

The windows are of the "picture window" type — that is, with the horizontal dimensions greater than the vertical. All will be sealed double pane windows having a factor of approximately 0.55. Specific corner windows on each level will be operable so that window washers will have access to the exterior from one corner. The window washer will place his safety strap in a continuous horizontal track and walk and wash on the continuous sill to the next corner window, and there will reenter the building.

The building will be of fireproof materials with fireproofed structural

From the air conditioning standpoint, the new Diagnostic building under construction in Rochester, Minn., for the Mayo Clinic will be one of the most interesting buildings in the Middle West. With its present 560,000 sq ft of gross floor area, it will be supplied with a total of approximately 430,000 cfm of conditioned air requiring an air conditioning load of 1700 tons. It will be one of the larger buildings in its territory equipped with aluminum wall panels, sealed double windows and aluminum louver exterior sunshades over the south facing windows . . . . . In thorough manner, Mr. Sturm has outlined the basic engineering analysis of a most difficult problem in such a clear manner that his article will be found of real value by air conditioning engineers and contractors.



NEW DIAGNOSTIC BUILDING for Mayo Clinic will be completely air conditioned, presented many interesting problems which are clearly analyzed in this article

steel framework, concrete pan and joist floors, plastered partitions and will employ various wainscot materials depending upon the nature of the space.

The south facing windows will have aluminum louver type sunshades or "eyebrows". These will fully shade the south windows from about May 1 until August 15. All windows will be equipped with interior drapes.

Air Conditioning Design Conditions

The design conditions established for this project, as well as most of the other Mayo Clinic buildings to be air conditioned, are as follows:

	Outside Design		
	DB	WB	WIND
Summer	95	75	—
Winter	—20	—	15 mph

	Inside Design		
	DB	WB	% RH
Summer	75	61.3	45
Winter	75	56.7	30

The inside design conditions are further qualified in that the main entrances and lobbies on the 1st floor will in all probability be maintained at a dry bulb temperature somewhat higher than that indicated above to reduce what is termed the "entrance and exit shock effect."

All room thermostats in the project will be equipped with internally adjustable stops which will allow the occupants to establish their own desired dry bulb conditions, within the limits at which the stops will be set. These limits are tentatively to be set on a 5 deg range, 72.5 deg to 77.5 deg. Along with this feature, the systems for the individually occupied spaces — such as examination rooms and private offices — are being designed so that a reasonably large proportion of these spaces will be able to maintain a temperature of 72.5 deg even during outdoor summer design conditions. It is thought, however, that after the first year or two of occupancy the number of individuals desiring this low temperature will be very limited. There is also the possibility that some individuals will want temperatures in excess of 77.5 deg (at least during the summer), and if such is the case the limiting stops on those thermostats will be raised accordingly. It is anticipated that no difficulty will result in endeavoring to maintain temperatures in excess of the basic top limit of 77.5 deg.

Why Unit Type of System Was Selected

The unit type system was selected as being that which would satisfy the air conditioning requirements of the numerous examination rooms, plus a fair portion of small private office spaces to be located in certain areas of the 2nd and 3rd floors. These requirements are:

1) Complete year 'round air conditioning of the individual spaces, including cooling and dehumidifying in the summer months, heating and humidifying in the winter months, and either of these two functions during spring and fall, depending on atmospheric conditions at any specific time.

2) A satisfactory rate of ventilation.

3) Reasonable air cleaning or air filtration.

4) Individual automatic temperature control of each space,

5) System to be as noise free as possible.

6) System should not be unduly complex and should not contain too many individual sub-units — with an eye toward reducing maintenance and parts replacements.

7) System must inherently or by special design overcome the stack action effect in tall buildings from unduly varying the ventilation rate volumes from lower to upper floor levels during changes in atmospheric conditions throughout the year.

8) Direction of air travel or exhaust from examination rooms must be from corridors into rooms.

9) Units should have sufficient winter radiation capacity to offset the space heat loss during the off hour periods when all fans should be shut down; also, the radiation should be placed under the windows for maximum comfort effect during the heating season.

After due consideration of the above requirements, the system selected is the high pressure induction unit type, wherein conditioned primary air is introduced through a floor type window sill outlet unit under a relatively high pressure difference between the unit inlet and its outlet or the room conditioned.

Vertical pipe shafts for both plumbing to lavatories which exist in each examination room and heating risers on the outside perimeter were already necessary and only slight modification was required to include space for vertical high velocity primary air ducts. For interior rooms, without outside exposure, pipe spaces are also required near the wall opposite the corridor, and in arranging them sufficient space was provided to conceal the room units which will have extension discharge ducts with wall outlet supplies.

The so-called primary air supply units for the above described spaces will be located in a service story

which will extend the full north-south length housing the public elevator machinery on the north and the staff elevator machinery on the south, as well as the ventilation equipment. This 11th floor equipment room will be almost the full width of the north-south bar of the cross plan.

Central Systems for Large Spaces

Air conditioning of the other spaces on each of the typical floors will be handled by conventional central systems with individual hot water reheat control of each major space. These spaces are the waiting rooms, public elevator lobbies, staff elevator lobby areas, and the seminar rooms. Toilet rooms, janitor closets, coat-rooms and like spaces will be connected to exhaust systems.

An unusual air conditioning application in this structure is the result of the necessity of requiring an air movement from the corridors into the examination rooms rather than the reverse as is usually the case with unit type systems. The reason is twofold. First, it was deemed advisable to prevent the air from examination rooms travelling into the corridors and thence into the toilet exhaust systems or major return exhaust openings. Second, the primary air supply or ventilation air volume which would amply meet the heat loss and gain, humidifying and normal ventilation requirements was considered to be insufficient to satisfy an extreme ventilation requirement which might occur because of a high odor concentration in one of these rooms. This ventilation requirement was based on experience in the 1928 Clinic building, which is completely ventilated but not air conditioned.

This unusual application is that all air supplied to a typical clinical floor through both the unit and central systems is exhausted through the examination rooms with the exception of that air which is exhausted at toilet rooms, janitor closets, etc., as previously mentioned. This air which is exhausted through each individual examination room results in a ventilation rate somewhat in excess of that provided in the 1928 building. Also, this air is not directly exhausted to the atmosphere, but is returned in substantial portion to the various supply units. This is also based on experience gained in the 1928 building in that the occasional local medical and clinical odors are insignificant and undetectable when mixed with the air from the whole system. There will still be a good portion of outdoor air in these sections of the building, close to 15 cfm per person.

Special Systems for Certain Areas

Certain of the clinical examination sections are considered to emit a clinical and/or medicinal atmosphere to a somewhat higher than the average degree and these will be supplied and exhausted with additional air by means of auxiliary systems which will deliver air to the rooms at basic room temperature and exhaust it in an amount slightly in excess of the supply. These areas will still be equipped with the same supply units and exhaust openings as other examination room. This standard system application will handle the heat gains and losses and also allow these special sections to be easily remodeled (from the air conditioning standpoint) into standard clinical sections, if required in the future.

Fortunately, the examination rooms included in these special sections are a small percentage of the total, thereby limiting the comparative size of the auxiliary systems. These auxiliary systems will have some capacity beyond the initial requirements to allow additional auxiliary ventilation to areas which might require it in the future.

For these auxiliary systems, vertical duct work will be extended through the typical floors in certain available locations or shafts and carried to the penthouse equipment room and capped. These ducts will be available for the future expansion of the auxiliary systems — supply or exhaust — as may be required.

Another interesting application in this building is the ventilation of the 10th floor attic space, which is being provided to reduce substantially the heat gains and losses from the roof to the 10th floor spaces. This method was employed in the design to eliminate separate primary reheat zoning and/or to allow the 10th floor units to be the same size as those on the other floors.

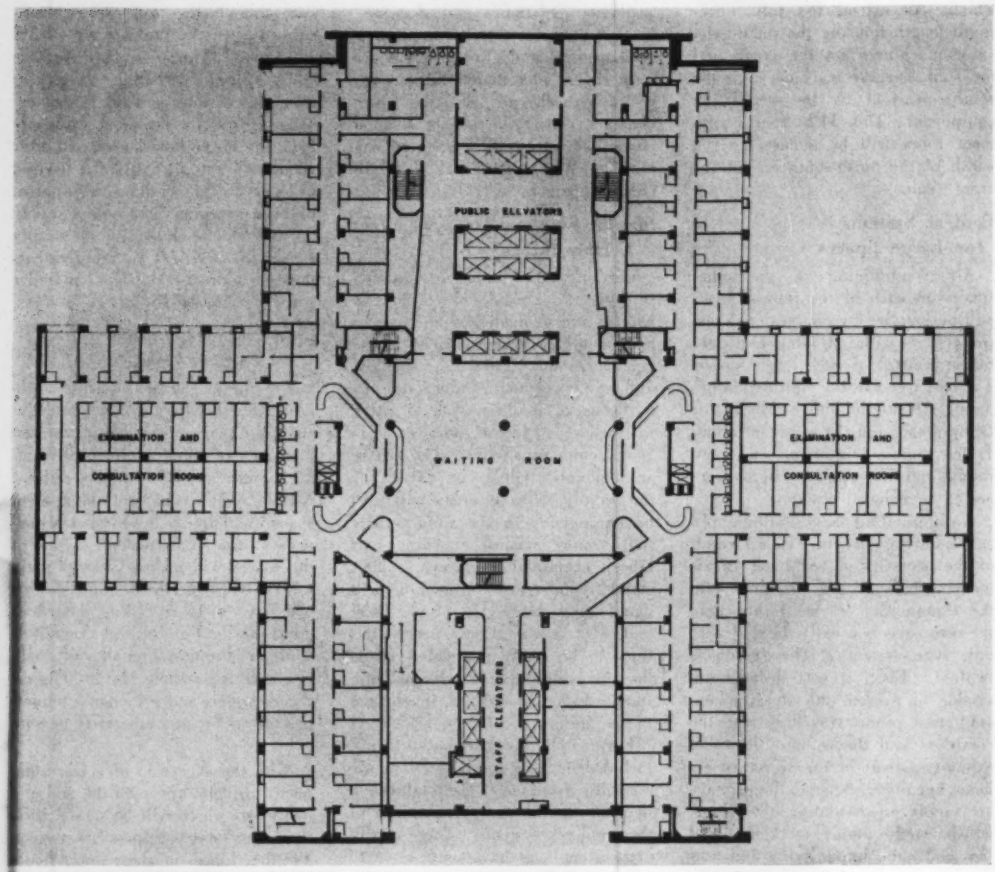
By doing this, the room units on the 10th floor will be the correct size without this "attic space ventilation" when the future eight stories are added. The air supply for this attic space ventilation originates from the various general return exhaust fans in the building, primarily from the lower four floors, and after ventilating the attic space a portion will pass to the penthouse equipment room and through a recooling supply air unit which will become the supply air for the auxiliary air requirements previously described. The remainder will be exhausted.

Lower Floors Consist of Larger Areas

The lower stories, partial sub-basement through the 3rd and including the mezzanine, will consist primarily of clinic administrative offices, some special clinical sections, X-ray and mechanical equipment space, the latter being located principally in the sub-basement. Some of the spaces will include a large main waiting room on the 1st floor, which will have a 16 ft ceiling, board of governors' room, several committee conference rooms, a number of smaller waiting rooms, large clinical record rooms and principally numerous offices for administrative personnel.

With the exception of a fair number of private offices on the 2nd and 3rd floors which will be served from the upper level high pressure system, all other spaces on these lower floors will be air conditioned from central systems with individual reheat for the various spaces. This reheat system will be forced hot water. The air units for these lower floors will be in the partial sub-basement equipment room at the west side of the building. Major horizontal duct distribution from this equipment room will run through tunnels under that part of the basement floor which does not have sub-basement space below.

In reality, the sub-basement equipment room is part of the basement having additional story height by dropping the floor a rather substantial amount. The basement and 1st floor elevations were established by grade for the 1st floor and a concourse connecting passage below the street level to the 1928 Clinic building for the basement floor. This established the basement to 1st floor height, which did not allow adequate



CROSS PLAN DESIGN of building provides an efficient arrangement for diagnostic clinic procedure. The design would have been impossible without air conditioning because of the many interior spaces

ceiling height for major horizontal duct distribution, and this was provided by running below the basement (as described in the preceding paragraph).

The sub-basement equipment room will be ventilated by its own separate filtered outdoor air unit and a return exhaust fan employing minimum supply air discharge temperature control by proportioning the outdoor, return and exhaust air quantities, the actual mixture quantities being established by equipment room heat gain and outdoor temperature.

There will be eight air conditioning supply air units in the lower equipment room. The return exhaust fans will be on the 3rd floor level in several small fan rooms which will discharge to two separate outdoor air-return air mixture shafts at the 3rd floor level. This outdoor air-return air will pass down to the supply units in the equipment room. Return exhaust fans can also deliver the air upward through the exhaust shafts which extend to the roof. The outdoor air-return air mixture for these central systems on the lower floors is designed at nominally 25 and 75 percent respectively except when conditions are suitable to provide cooling with 100 percent outdoor air. The mixture point for the outdoor air-return air is at the 3rd floor level to allow a long travel to the intake of the supply units and thereby accomplish better mixture of the two air masses.

Construction of Main Supply Units

Each air conditioning unit of the central system type will consist of preheat coils, automatic travelling curtain oil filters, spray coil air washers with chilled water coils and supply fans. Reheat coils — as previously mentioned — are located in the various spaces.

After considerable discussion with clinic personnel, it was decided that the type of air filters for the new building could be identical to those used in the 1928 building. This decision was based on the fact that a higher degree of filtering efficiency was not considered necessary from the standpoint of diagnostic procedure or for redecorative reasons (based on the experience gained in the 1928 building). The filters used in the 1928 building are the permanent metal, cleanable impingement filters; automatic impingement filters were selected for the new building because of the considerably larger volume of air handled.

The central systems in the elevator penthouse are identical to those in the lower equipment room, except for an additional bank of preheat coils because of a higher percentage of outdoor air necessary in these units to balance the exhaust requirements of the upper floors.

The primary air units for the make-up or supply air to the individual room induction units on the examination floors are similar to the central systems units, except that the cooling coil surfaces are greater in proportion to the quantity of air handled and the supply fans operate at higher static pressures.

In all, there are 16 supply air units, including the primary air systems for the room units, and they have a combined capacity of 430,000 cfm of air, all of which, with the exception of the sub-basement equipment space unit, is air conditioned. There are 20 return and/or exhaust fan units, handling approximately the same volume as the supply units.

The two main entrances to the building will each have pressurized heating systems consisting of comparatively large central system type supply air units connected to both an outdoor air supply and a return from the vestibules of the entrances. The amount of outdoor air heated and delivered by the units will be governed by the amount of natural infiltration effect. In warm summer weather, these systems will not be operated because the natural effect at that time will be one of exfiltration — tending to keep the entrance vestibules at building conditions.

Balancing Floor-to-Floor Air Quantities

All standard velocity duct systems connected to the so-called central systems passing vertically through the building will be orificed for positive summer to winter determination of calculated air quantities on each floor. [For further information on this point, see the author's articles on Vertical Air Distribution in HPAC, June and September 1947].

All horizontal take-offs or branches from vertical trunk ducts will be orificed for a specific resistance so that the stack effect of the structure will be small in comparison to the orifice resistance. These orifices will be used except where the resistance of the branch duct to the first outlet or inlet is greater than the calculated required orifice resistance necessary to overcome satisfactorily the tendency of stack effect to vary the air quantities from floor to floor with changes in atmospheric conditions.

The primary air supply ducts or conduits for the induction unit system for the typical examination floors do not require this special orificing. The primary air velocity employed within the room unit to induce the required flow of secondary air is created by establishing a suitable pressure difference between the interior of the unit and the room. This pressure difference, which is transformed into velocity pressure, is more than sufficient to prevent the stack effect from materially varying the summer to winter air delivery volumes through the units from floor to floor.

Central Plant To Supply Chilled Water

A central plant producing chilled water is being constructed one block from the site and is designed to handle the Diagnostic building as well as other Mayo Clinic properties in the general locality of the plant. This chilled water plant is an addition to the Franklin heating station, which has supplied heat, light, power, water and compressed air to the clinic buildings for some 20 years.

Water will be chilled at the plant to 40 deg, pumped through underground mains to the various buildings and returned at a nominal temperature of 55 deg. Centrifugal refrigeration machines, some steam turbine driven and some motor driven, will produce this chilled water. A large cooling tower will provide the condensing requirements.

This new Diagnostic building will also be supplied with steam, electricity, domestic hot water supply, compressed air and condensate return services from the heating station.

Heating and Piping Services

The heating system of the typical examination floors has already been described as part of the air conditioning equipment. For the 1st floor, where central systems are used for air conditioning, and for stair wells, radiation will be installed at all exterior walls where windows occur. This radiation will be recessed finned tube convectors on a forced hot water heating system. Convectors and pumps for this system, as well as the lower floors' air conditioning reheat system, will be in the sub-basement equipment room.

The plumbing system is extensive and relatively complex in that each examination room is equipped with a clinical lavatory. The clinical X-ray section will be equipped with a number of automatic film developing machines which will be piped for delivery of hypo and developer solutions prepared at a central location. Waste from the developer tanks will also be piped to a central location where evaporators will dehydrate it for silver recovery.

The building will be divided into two levels of pressure zones for domestic water. The lower will consist of the sub-basement through the 3rd floor with the remainder of the building on an upper higher pressure zone. When the future stories are added, still another zone will be required.

Since sewer mains in the street are above the basement and sub-basement floor levels, all sanitary drainage will be handled by a duplex sewage pump installation. Elevator pits at a level lower than the sewage ejector will be drained by individual sump pumps and they will also collect drainage from drain tile surrounding the foundation. Warm or tempered and softened water for the building and domestic warm water source will originate from the Franklin heating station as generation condensing water.

Fire Protection and Smoke Detectors

Fire protection will consist of four 6 in. standpipes with 2½ in. outlets, plus ten 4 in. standpipes for 1½ in. additional hose cabinets to give a full floor coverage with 75 ft streams. There will also be some sprinkled locations in basement storage areas. The continuous curtain, automatic oil filters will also be equipped with fire protection sprinklers.

All fans delivering air into occupied spaces will be equipped with electric eye smoke detectors to close dampers automatically in the event of smoke in the system. All central system duct work, both supply and exhaust, will be equipped with fusible link actuated fire dampers as

required in branch connections to mains which pierce fireproof floors.

Water supply for the standpipes and sprinkler system will originate from the city mains and the pressure necessary for the standpipes will be furnished by an automatically controlled motor driven 750 gpm centrifugal fire pump, the system also having the usual siamese connections for fire department pumpers.

A central vacuum cleaning system similar to that in the 1928 building will be installed. Outlets will be located on centers to allow cleaning the entire floor area by using 50 ft hoses. The vacuum blower or exhauster and filters will be in the lower equipment room with the discharge being exhausted to the atmosphere. In all, twenty-four 3 in. risers will be extended through the building to provide the desired coverage.

Snow Melting for Sidewalk, Driveway

The entire sidewalk surrounding the building will be provided with snow melting systems, as will the service driveway, which is the entire open square at the southwest corner of the building. This results in a total of approximately 12,000 sq ft of sidewalk and 4000 sq ft of driveway to be treated. The driveway will be handled from one system, while the sidewalk will be serviced by two systems, each taking half of the perimeter of the building. Converters and pumps will be located in the basement equipment room with expansion tanks and fill points at the 1st floor level. Approximately 1300 gal of antifreeze solution mixed with about an equal volume of water will be required to fill all the snow melting systems.

Instrument Panelboard Centralizes Control

A large central instrument panel adjacent to the operating engineer's office, which is near the sub-basement equipment room, will be the control point of all mechanical equipment in the building. On this instrument panel will be pushbutton pilot light stations for all fan and pump motors in the building. For units which start automatically, from such controls as float switches for sewage pumps, warning lights on this panel will indicate high water level. Gages indicating pressures and temperatures of services such as steam, condensate return, city water, chilled water, snow melting, etc. will be part of the panel. Fire protection alarm bells and lights will also be included.

The most interesting equipment on this panelboard will be the electronic temperature recorder in conjunction with an electronic indicating thermometer. The 10 point recorder and the indicating thermometer will be arranged so that through a series of transfer plugs and terminals any one of some 100 stations normally connected to the indicator may be disconnected and plugged into the strip recorder for any time interval desired.

This arrangement will enable the operators to record continuously for a day, week or month any one of the electronic thermocouple stations in the building. This will assist in general maintenance and operation as well as help to determine causes of any difficulties which may arise. There will be the customary clock on this panelboard and the board will be designed around a large metal office desk, complete with phones, file drawer space for log sheets, etc.

This new Diagnostic clinic is being designed by Ellerbe and Co., Architects and Engineers, St. Paul and Rochester, Minn. Norman E. Bueter, Consulting Engineer, Chicago, has been retained as air conditioning consultant to assist in the check of the conditioning design for this large building.

Contractors building the project are Stocke and Olson, building contractors; The Sanitary Co., heating, piping and plumbing; Utility Sales and Engineering, ventilating and air conditioning; and Foster Electric Co., electrical work; all of Rochester, Minn.

Insulation of Ceiling To Save $1400 A Year

AN ANNUAL SAVING of $1400 in cost of heating Detroit's post office and court house is expected to result from insulation of the 10th floor ceiling. Installation of fiber glass blowing wool in the 44,000 sq ft area has been completed as part of a modernization program.

A. E. Loyal, president of Insultex Co., the firm which installed the insulation, estimates that a saving of more than 5 percent on fuel cost will result. Edmund Z. Tobola, superintendent, Public Buildings Service, said that the average yearly cost of heating the building in the last two fiscal years amounted to $26,700. On this basis, installation of the blowing wool, which cost $4000, will pay for itself in three years, Mr. Loyal said and thereafter will be equivalent to an annual return of 35 percent on the investment. Mr. Tobola pointed out that it has been difficult to heat the 10th floor, and the 4 in. of insulation is expected to solve this problem.

The blowing wool was propelled by air from a truck on the ground to the 10th floor ceiling area 180 ft above, through a 2½ in. rubber hose (see photo).

The building, one of the largest post office and court houses in the nation, constructed at a cost of $4 million, was completed and occupied in 1934. Housing 49 separate governmental agencies, it is of limestone sidewall construction and stands on the site of the original Fort Shelby. (Photo courtesy Owens-Corning Fiberglas Corp.)

SHEET METAL STRETCHER powered by air operated jaws is one of the many uses of compressed air power in industry

How To Get Top Efficiency from Compressed Air Power

By Edmond C. Powers, Educational Director
Compressed Air and Gas Institute

Piping serves American industry in many ways, and one of its most important production and maintenance operations is in making compressed air at the proper pressure and in the proper amounts available at the right points of use. Manpower, material and equipment shortages stress the need for getting peak efficiency from compressed air power systems.

EVENTS OF RECENT months — and those anticipated for the near future — have served to re-emphasize strongly the basic importance of American industry to the future welfare of the entire world.

Industry of the United States is facing a greater challenge than ever before. To meet military demands in the interests of national security while at the same time satisfying civilian needs, the American industrial machine must reach new heights of accomplishment.

Meeting the challenge will very likely require getting along with less manpower, material shortages and equipment scarcities. This means that American industry must do one or the other, or a combination, of two things:

1) It must increase the efficiency of its present production procedures.

2) It must install additional pro-

TABLE 1—PERFORMANCE CHECK CHART for direct connected motor driven two-stage stationary compressor

Size of compressor cylinders, in.	21 & 13 x 14		
Piston displacement, cfm	1546		
Rpm	277		
Discharge pressure, lb per sq in. ga	100		
Altitude, ft above sea level	0		
	Full Capy.	¾ Capy.	½ Capy.
Actual capacity, cfm free air	1329	996	664.5
Brake hp at compressor shaft	242	188.5	135
Bhp per 100 cfm actual capacity	18.25	18.9	20.3
Motor efficiency, percent	92.5	92.2	90.9
Electrical hp input per 100 cfm actual capacity	19.73	20.5	22.3

duction equipment when needed and when available.

The information in this article applies to checking the performance of industrial plant compressing equipment, the distribution system and the air powered tools and equipment to assure maximum productive efficiency. Selecting additional compressors and air powered tools and equipment in case the present equipment at peak efficiency is found to be inadequate to meet production demands will be treated in a second article.

Judging Performance of Compressors

When judging the performance of any compressor, it is essential to recognize the real criteria of compressor efficiency. These are the actual capacity of the compressor and the energy or power it requires per unit of air, or gas, actually delivered.

For comparison purposes, performance check charts are given in Tables 1 and 2.

The physical properties of many gases are not accurately known and there are many gas mixtures in which the relative proportions either are unknown or do not remain constant. It is impossible to predict accurately the performance of compressors handling such gases. Performance guarantees on gas compressors are usually based on handling air.

Attention is invited to the different economy bases used for steam and for motor driven compressors. Steam consumption of steam driven compressors is given per 100 cu ft of free air actually compressed, whereas on motor driven machines, it has been the custom to divide the horsepower of the compressor by the actual capacity per minute, and express the performance in horsepower per 100 cfm actual capacity.

The actual capacity is determined by a low pressure nozzle test conducted in accordance with the American Society of Mechanical Engineer's test code. Steam consumption is determined in accordance with the ASME test code for steam engines. The oil consumption of a diesel engine driving a compressor is measured in accordance with Diesel Engine Manufacturers Association (DEMA) standards.

Performance Check of Engine Driven Compressors

The overall performance of a portable compressor is expressed on the basis of the number of units of power input (gasoline, fuel oil or electric power), per unit of air output; e. g., lb of fuel per cu ft of air delivered, or in case of electric motor drive, kw input per cu ft of air delivered. Alternatively, the performance of a portable compressor may be given as cu ft of air actually delivered per gal of fuel or, for an electric motor driven unit, cu ft of air delivered per kwhr.

TABLE 2—PERFORMANCE CHECK CHART for steam driven stationary compressor: compound steam with two-stage compressor cylinders

Size of compressor, in.	14 & 22-21 & 13 x 14		
Piston displacement, cfm	1507		
Rpm	270		
Steam pressure at throttle, lb per sq in. ga	150		
Back pressure at L.P. exhaust, lb per sq in. ga	2		
Superheat at throttle	50 F		
Discharge pressure, lb per sq in. ga	100		
Altitude, ft above sea level	525		
	Full Speed	¾ Speed	½ Speed
Actual capacity, cfm free air	1345	1009	673
Rpm	270	202.5	135
Indicated hp in steam cylinders	258	189	122
Steam consumption, lb dry steam per hp per hr	19.5	20.0	20.7
Steam consumption, lb per 100 cu ft free air actually delivered	6.23	6.24	6.26

The input measurement should be corrected to standard units as defined below.

(a) Gasoline engine drive.
Gasoline measurements should be referred to standard U. S. gallons, weighing 6.16 lb per gal and having a heat value of 20,260 Btu per lb.

(b) Diesel or fuel oil engine drive.
Oil measurements should be referred to standard U. S. gallons, weighing 7.2 lb per gal and having a heat value of 19,000 Btu per lb (See Diesel Engine Manufacturers Association Standards.)

(c) Electric motor drive.
Electric power input measurements should be reduced to kw. (For test procedure see ASME power test code.)

For checking the efficiency of any particular make and type of compressor, the assistance of the manufacturer may be desirable.

Regulation of Compressed Air Plant

Since the demand for compressed air usually varies widely from time to time, some form of capacity control is required. Two general methods are available. The first, known as speed and pressure regulation, varies the speed of the compressor according to the demand for air, such as is usually done in a steam driven compressor. The second, known as constant speed regulation, operates the compressor at a constant speed and varies the capacity by any one of several types of unloading systems, as is usually done in a motor driven compressor.

For general industrial use, control of pressure closer than a 5 percent range between full load and no load is unnecessary and should be avoided. Much closer regulation of the pressure can be provided where special conditions require it.

Wherever possible, pressure regulators should be so selected and adjusted that large units will act as base load units and unloaded only after smaller units have been shut down. Of course, where the requirements have diminished to where one of the smaller units could handle them, the large unit should be shut down. In this way, the overall economy will be improved.

Piping Determines Compressor Location

The location of a compressed air plant with relation to the points of air use should be given study. A central plant housing all the compressors involved has advantages in unified operation and care, better supervision and probably less labor cost. In a central plant, it is probable that no more compressors will

be kept operating than are necessary to maintain pressure. The load factor and operating efficiency of each unit will, therefore, tend to be relatively high.

It is possible, however, that a central plant cannot be located so that satisfactory distribution of air and maintenance of pressure may be obtained without excessive piping costs. In such a case, it may be better to divide the compressor plant into two or more installations at or near specific load centers, interconnecting the plant piping so that air may be distributed either way to meet peak load requirements. Of course, the plant should be placed as close as possible to the larger load centers. This reduces piping costs and results in higher pressure at the tools with closer control of the pressure.

Where two or more compressors are installed in various parts of the plant, the equipment should not be placed in some obscure corner with no one to look after it. Such an installation will surely be neglected with costly consequences.

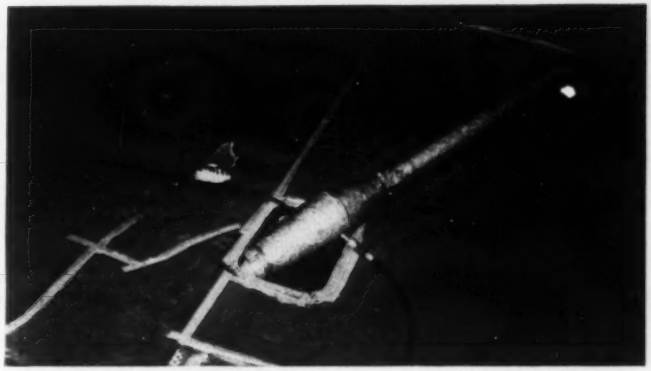
Low Air Pressure Is Wasteful

Low air pressure is an abuse of the compressed air system — it is a costly and wasteful practice which should not be tolerated. Ignorance of the effects of low air pressure contributes more than any other single factor to a lack of appreciation of the effectiveness of compressed air power.

By "low air pressure" is meant inadequate pressure at the tool or the device which is air operated. It is at this point that the air is used as power. Only the pressure and volume of air available at the point of use can be effective in doing work. Most pneumatic tools, for example, are designed to operate at 90 lb ga maximum at the tool. This means pressure at the point where the air enters the tool while the tool is operating. If the pressure is below the range of 85 to 90 lb ga, then it should be considered too low since it reduces the ability of the tool to do the maximum work for which it was designed.

The causes of low air pressure are insufficient compressor capacity, inadequate piping and leakage.

When it is discovered that pressure is too low, the first inclination is to install more compressor capacity. This is not necessarily the correct answer. It should first be determined whether the compressors are at full load when the air pressure is low. If they are, then more compressor capacity may be required but even then, consideration must first be given to two other common causes of low air pressure.



"BAZOOKA" MAKING USE OF compressed air draws fumes from enclosed spaces needing ventilation

Inadequate Piping a Cause

The second cause is "inadequate piping." A measure of the adequacy of piping is the pressure loss between the air receiver, where the compressor endeavors to maintain a constant pressure, and the point of use. This should not exceed 10 percent in a well designed system. The absolute maximum drop for the worst point in the system should not exceed 15 percent. If the pressure drop is greater than 10 percent average or 15 percent maximum throughout the entire distribution system (including hose), then attention should be given to correcting this fault before considering increased compressor capacity.

A third cause of low air pressure is leakage or loss of air without doing work. It has been pointed out that permitting excessive leakage is the same as exhausting the output of a compressor to atmosphere.

Obviously, if leakage is eliminated, the compressed air formerly wasted will be available for useful work. The expense of making lines tight will undoubtedly be less than the installed cost of a new compressor, while the daily power saving may be considerable.

The gas industry considers a loss of more than 1 cfm per *mile* of 3 in. line as excessive.

Elimination of leakage is certainly a sensible step toward maintaining air pressure and conserving power.

Effects of Low Air Pressure

There are very few uses of compressed air not vitally influenced by low air pressure. Portable pneumatic tools, rock drills, concrete breakers, hoists, scrapers, loaders, all pneumatic transfer and conveyor systems, paint sprays, oil burners, sand blasts, air lift pumps, etc., operate less effectively when the proper air pressure is not maintained.

The positive results of increasing air pressure to the proper value are increased production and reduced cost per unit produced.

Since the two are interdependent, they will be discussed without attempting to differentiate them.

Considering rock drills as a distinct class of air powered tools, it has been found that increasing air pressure at the drill from 70 lb ga to 90 lb ga results in about 41 percent increase in drilling speed. This is an average for eight different types and makes of drills.

This increase in drilling speed was not accompanied by corresponding increase in the cost of operation. Air consumption of the drills increased only 32 percent, while the labor cost did not increase at all — thus greatly decreasing the total cost per unit of work done.

The economic advantages of increased air pressure (or conversely, the losses due to low pressure) can

TABLE 3—DATA FOR SHOWING advantages of increased air pressure

Operating air pressure at compressor, lb ga	100	100
Operating air pressure at tools, lb ga	70	90
Tool load factor, percent	33	33
Cfm required per tool at maximum load	50	68
Number of men and tools	20	20
Total cfm used	333	450
Total cu ft used per 8 hr day	160,000	216,000
Cost of air per 1000 cu ft	$ 0.05	$ 0.05
Cost of air per day	8.00	10.80
Increased air cost	—	2.80
Labor rate per 8 hr day (incl. burden)	16.00	16.00
Total labor cost per day	320.00	320.00
Total cost per day	328.00	330.80
Ratio of air cost to total cost, percent	2.4	3.3

be very nicely illustrated by considering portable pneumatic tools, such as grinders, drills, chippers, riveters, wrenches, sand rammers, etc. For example, an average increase of 37 percent in production can be obtained for about 30 percent increase in air consumption by increasing the air pressure at the tools from 70 to 90 lb.

Consider an installation of 20 grinders operating from an $8500 compressor plant, first at 70 and then at 90 lb ga.

With power at 1c per kwhr, fixed charges at 15 percent of installed cost, plus labor and supplies, air at 100 lb pressure costs 5c per 1000 cu ft. Table 3 gives pertinent data.

Assuming that only one-third of the 37 percent increase in tool productivity can be translated into labor productivity, it is evident that 12 percent more metal will be removed with 90 lb ga air pressure than with 70 lb. The work previously done for $328.00 can now be done in less time and will reduce the cost to $330.80 divided by 1.12, or $295. Thus, even though air costs are increased, there is a net saving of some $33 per day, or about $8500 per year (equal to the first cost of the compressor plant).

Analyzing this another way, when the pressure is increased to 90 lb ga, the tools require 120 cfm more air. A compressor with motor and auxiliary equipment to supply about this amount of air would cost, say, $2200. The saving of $33 per day would pay for this new unit in 67 working days — less than three months.

When the question arises of purchasing additional compressor capacity as opposed to making other arrangements for the operations involved, it should be remembered that adding to compressor plant capacity frequently affords protection for many vital shop operations other than the operation of pneumatic tools. Among these are sand blasting, paint spraying, hoisting, agitation of liquids, air jet vacuum equipment for cleaning foundry sand, operating controls in power plants, air chucks in a machine shop, safety devices on punch presses, air jets for ejecting parts from presses, etc.

Remedies for Low Air Pressure

The remedies for low air pressure are just as definite as the causes and effects.

Faulty air power conditions are usually due to poor planning or to increased air uses without corresponding system expansion. Plant-wide analysis should determine the full extent of low air pressure and the present air flow requirements. Future growth must also be considered.

Pressure loss varies roughly as the square of the velocity of air flowing through the pipe. For example, a 3 in. line, 1000 ft long, will handle 500 cfm with a 2.5 lb pressure loss, while a 4 in. line will pass about 1000 cfm with the same drop. The *installed* cost of the 4 in. line will, however, be very little more than that of the 3 in. line.

Methods of increasing pipe line capacity to decrease pressure loss and improve conditions at the point of use vary with different installations. One may call for a line paralleling the original, with frequent interconnections; another may require installation of a loop system with some outlets taken off the new line to relieve the old; still another may need a complete new system.

Branch lines and manifolds for attachment of tools, etc., should be planned "oversize."

Not the least of the problems of correct system layout is the selection of proper hose for final transmission of compressed air to the tool. Losses of 15 to 25 percent in air pressure are frequent in the hose alone. *Don't* use a hose longer than is necessary to make the tool available to the work and to give proper freedom of movement to the operator.

Every cubic foot of leakage eliminated is pure gain. Such losses in many systems will reach 10 to 20 percent of the total air compressed. An air leakage test should be run on the complete plant and every section of hose should be inspected. Although leaks are usually small, they may be numerous and have a high total effect. A single 1/16 in. hole will waste 182,000 cu ft per month.

The most likely locations of small leaks are around valve stems, in hose connections, unions, drains, homemade blow guns and lines leading to inoperative tools.

Elimination of leakage involves making the system tight, and then *keeping it tight*. Regular inspection is mandatory.

Only after it has been determined that the distribution system is adequate and that leakage has been eliminated should increase in compressor capacity be considered.

Compressed Air Distribution System

Any drop in pressure between the compressor and the point of use of the compressed air is irrecoverable loss. The distribution system is, therefore, one of the most important elements of the compressed air plant. In checking it, the following general rules should be observed.

1) Pipe sizes should be large enough so that the pressure drop between the receiver and the point of use will not exceed 10 percent of the initial pressure.

2) Where possible, use should be made of a loop system around the plant and within each shop and building. This gives two-way distribution.

3) Long distribution lines should have liberal size receivers located near the far ends or at the points of occasional heavy use. Many peak demands for compressed air are instantaneous or relatively very short and storage capacity near such points avoids excessive drop.

4) Frequent outlets should be provided on each header or main for attaching hose for air operated equipment, always putting the outlet at the top of the pipe line to prevent carryover of condensed moisture to the tool. Frequent outlets result in shorter hose length and, therefore,

less pressure drop through the hose.

5) All piping should be arranged so that it slopes toward a drop leg or moisture trap in order that condensed moisture may be removed from the piping system and prevented from being carried over into the air tools or compressed air operated devices where it is very harmful.

In checking the distribution system, it should be remembered that oversize piping costs little more than smaller size.

Obtaining Maximum Efficiency from Tools

The importance of obtaining maximum output from tools of all kinds cannot be over-emphasized. This is true because labor is by far the largest item in the total cost of manufactured products. Any reduction in the efficiency of the tools will therefore materially increase the unit cost of production.

Maximum output of pneumatic tools requires an ample supply of air at the proper pressure at the tool itself so that the tool can develop full power.

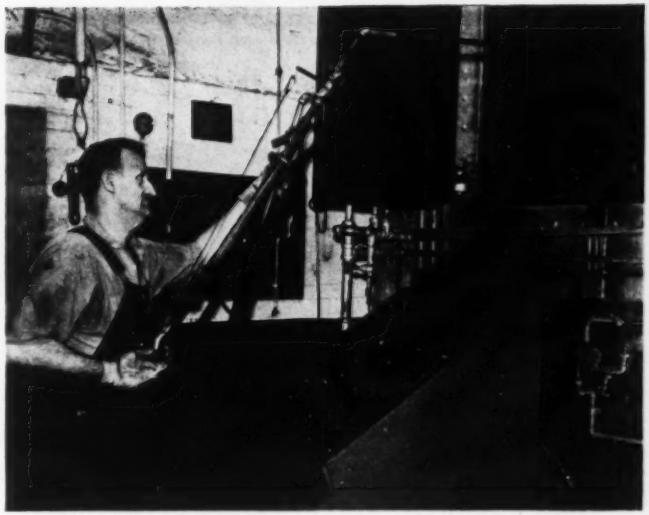
A hypodermic needle attached to an air gage will show the air pressure actually available at the tool. It must be emphasized that the pressure shown at the compressor does not indicate the pressure delivered at the tool itself while the tool is running. Such a test may indicate that only 60 lb pressure is available at the tool, instead of 90 lb and, if the condition is remedied, production will be increased from 25 to 50 percent, provided the tools are in good condition and can deliver the increased power provided by the increased pressure.

Careful consideration must be given also to the size and length of hose to use, for hose can very severely restrict the air pressure delivered to the tool. The size of hose should be as large as practicable and as short as possible.

The importance of obtaining maximum efficiency from pneumatic tools is illustrated by the following figures:

If 10 men operate pneumatic tools 8 hr a day, with labor and overhead costing $2 per hr, their time will cost $2 × 10 × 8 = $160 per day.

If their output can be increased only 10 percent, by improvement in the air supply, the saving will be 10 percent of $160, or $16 per day.



QUICK WAY TO CLEAN BOILER TUBES. Compressed air at 170 lb comes from rubber hose into pipe. Metal disc at end of pipe dislodges soot and air pressure forces it on through tubes. Air valve is controlled by chain leading to handle of device

If 10 tools consume an average of 30 cfm of air under poor conditions, assume that the consumption would rise to as high as 45 cfm in order to develop full power and realize the 10 percent additional production indicated above. This would mean:

15 more cfm of air × 10 tools or 150 additional cfm at full use.

If the tools are in use one-half the time, the actual extra air required is 150 cu ft × 50 percent or 75 cfm.

This additional air would cost as follows:

75 cfm × 60 min = 4500 cfh.

At a cost of 5c per 1000 cu ft = 22½c per hr.

Or, for a day of 8 hr, $1.80.

This contrasts with the saving of $16 per day.

If proper air supply from the compressor is already available, the cost of realizing this substantial saving is limited to the cost of correcting the distribution system and the hose. The valves should be checked, nipples in the ends of tools should be eliminated, proper hose provided, etc.

The production efficiency check-up, as it involves pneumatic tools, should pay particular attention to the following, in connection with which the assistance of air tool manufacturers may be desirable.

1) The correctness of application of tool to job.

2) Use of correct accessories with the tool.

3) Operation of tool at proper speed.

COMFORT CONDITIONING TO BE COMMONPLACE

LOOKING INTO THE future, John R. Hertzler, Vice President and General Sales Manager of York Corp., said he expected the scientific and industrial developments now being made during the rearmament program would emerge as new products for future civilian markets.

"The present critical times will give birth to new designs and production methods which will further our standard of living and enhance our well being, and I predict that we will see the day when comfort air conditioning will be as commonplace as today's family refrigerator", he said in addressing some 300 dealers and distributors of the North Atlantic district meeting at the Hotel Biltmore in New York.

Air conditioning and refrigeration are essential factors in the multitude of industries and services geared to national defense, he noted.

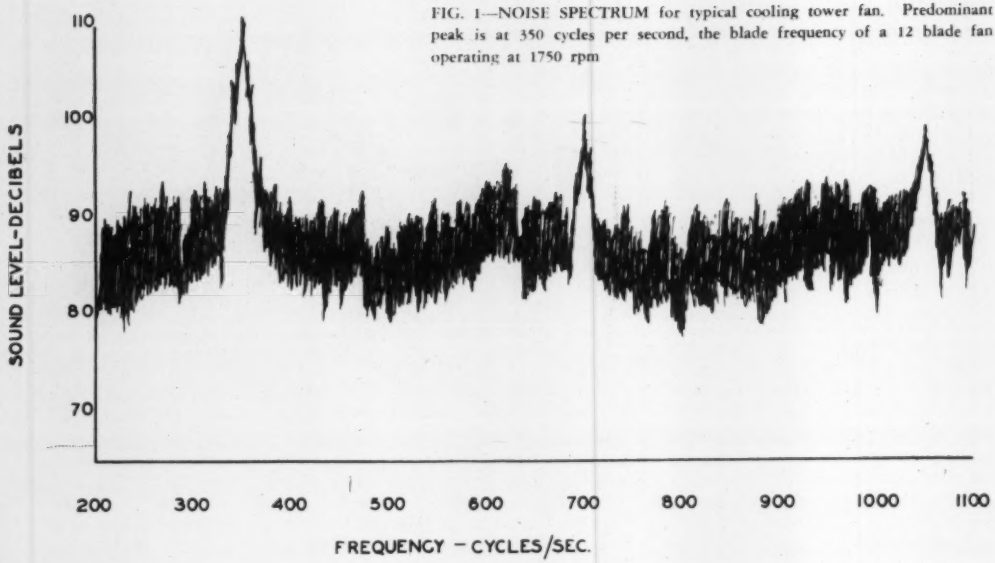


FIG. 1—NOISE SPECTRUM for typical cooling tower fan. Predominant peak is at 350 cycles per second, the blade frequency of a 12 blade fan operating at 1750 rpm

How Cooling Tower Noise Has Been Reduced

By Richard D. Lemmerman

In the installation of air conditioning cooling towers, the possible effect of airborne noise on the tenants of surrounding buildings should be considered. Action taken by them through the courts may cause the tower owner considerable loss in patronage as well as good will. It is recommended by the author that the silencing of the tower be investigated prior to the initial operation, thus eliminating cause for complaint before annoying conditions can arise.

ENGINEERS, CONTRACTORS and architects have long been cognizant of noise problems with air conditioning systems, and much has been written on the subject. However, the majority of these references consider only the noise transmitted through the duct work and piping into the conditioned rooms.

A second and sometimes more critical problem associated with air conditioning equipment is the effect of cooling tower noises on the occupants of surrounding buildings. The problem becomes particularly important when the cooling towers are on a level equal to or lower than the windows of surrounding buildings, such as in a depressed courtyard or on the roof of a low building in the midst of higher structures. Since it is often more economical to place the tower in a lower level court, rather

Mr. Lemmerman is vice president in charge of engineering, research and development of Industrial Sound Control, Inc., and Carl W. Lemmerman, Inc., an acoustical consulting and engineering firm. A graduate of Massachusetts Institute of Technology, he specialized in physics and chemical engineering.

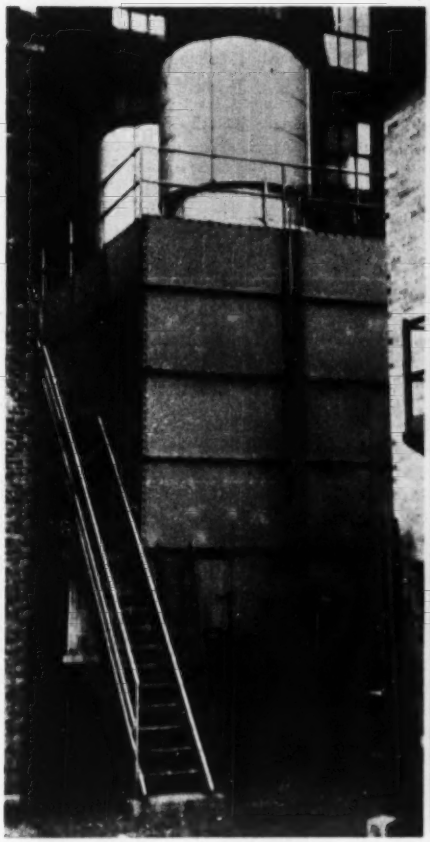


FIG. 2—CYLINDRICAL MUFFLERS atop this department store cooling tower, and intake silencing units at lower left, corrected the noise problem after system had been shut down because of a court order

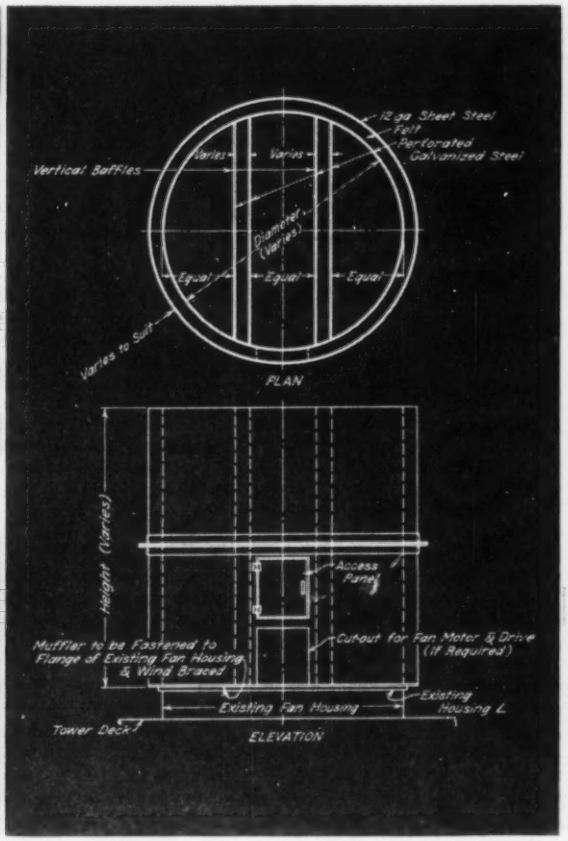


FIG. 3—TO QUIET FAN EXHAUST, a muffler may be attached to the top of the fan throat housing, as detailed here. Exhaust passes through parallel channels formed by dividing lined chamber with vertical baffles

than use additional piping to the upper roof, this installation condition is not unusual.

In the case of hotels with air conditioning cooling towers in partially enclosed courts, the annoying noise in many instances has caused complaints and subsequent loss in trade. In cities with anti-noise ordinances, complaining tenants in nearby buildings have obtained court injunctions forcing a shutdown of air conditioning equipment. This has left the store, theater, restaurant, or other business in question without the benefit of air conditioning. In at least one instance, criminal proceedings were brought against a theater owner whose cooling tower was annoying tenants in an adjoining apartment house.

Noises are generated in a cooling tower from three major sources: (1) the fan or blower; (2) flowing air turbulence; (3) water falling.

Noise Sources in Cooling Towers

The motor and fan blades are generally the predominant sources of noise emanating from a cooling tower. These fan noises can be further sub-divided into two classifications, as follows: rotational and vortex.

The rotational noises consist of the blade fundamental plus two or three of its higher harmonics and are caused by the periodical chopping of the air stream by the fan blades and by the thrust and torque applied to the air.

Vortex noise may be described as that caused by the shedding of vortices from the surface of the fan blade and is dependent upon the angle of attack, air velocity and its degree of turbulence, and the general blade shape. In much air conditioning work where the ratio of maximum fan tip speed to the velocity of sound is less than 0.12, the vortex noise predominates over the rotational.

Fig. 1 shows a typical noise spectrum for a cooling tower. All frequencies are present to some degree, but the predominant peak is at 350 cycles per second. This is the blade frequency of a 12 bladed fan operating at 1750 rpm. This blade fundamental can be calculated from the equation:

$$\text{Blade Fundamental} = \frac{(RPM)(NB)}{60}$$

where *RPM* is the number of revolutions per minute and *NB* the number of fan blades. Accompanying this frequency are peaks of the first and second harmonics to a lesser intensity at 700 and 1050 cycles per second. The vortex and turbulence noises give the general background to these fan peaks.

When gases flow through a cooling tower, obstructions of all types (pipes, fan throats, projecting bolts, etc.) produce additional vortices and eddies. As a result of this turbulence, noise of all frequencies is produced. However, the middle frequencies — from 300 to 2000 cycles — are usually predominant.

Sometimes this turbulence will set various parts of the system into vibration, resulting in a definite resonant pitch. Turbulent noise is a function of the air velocity and the shape and area of the flow obstructions. These secondary air turbulence noises usually do not contribute to the overall noise level as much as the fan does, but in cases of high velocity or of internal tower resonance, the conditions may well be reversed so that the fan noises are of minor consequence in the overall sound level.

The noise of the falling water in a muffled cooling tower is almost unnoticeable, as the fan and turbulence noises predominate. However, after the fan exhaust has been acoustically treated, the water-falling sound from the tower inlets has in several cases led to complaints. People will pay well for a hotel room within ear-shot of Niagara Falls, but raise objections to the same sound outside the windows of their city apartment. The water contributes some major low frequency components emanating from the cooling tower intake louvers and must be considered in silencing this equipment.

Noise Levels of 110-120 Decibels

The combination of the three above-stated noise sources has been found to give sound levels up to 110 to 120 decibels. These levels must be compared to the ambient noise level of the area without the equipment operating.

Measurements of ambient conditions in a typical cooling tower location off 54th St. in New York City showed a daytime average of 75 to 80 decibels, and an average at night of 55 to 60 decibels. These readings can be considered as fairly representative of cooling tower locations in partially enclosed courtyards.

Reduce Noise to the Ambient Level

The problem is to reduce the noise emanating from the cooling tower from the operating level of 110 to 120 decibels to the ambient levels during the operating time. This latter level may be the night ambient in the case of a hotel, but only the day ambient with a department store, for example.

Muffling systems for cooling tower intakes and exhausts have been used to accomplish such reduction. In the case of the fan exhaust, a cylindrical muffler may be attached to the top of the fan throat housing, as is shown in Fig. 2. Such mufflers should be designed to have very low pressure drops across them, since in the treatment of most older cooling towers, any substantial flow restriction necessitates enlarging the fan or fan motor. The pressure drop through a typical 8 ft high by 10 ft diameter muffler might be of the order of 0.02 in. of water. The exhaust gases pass through a series of parallel channels formed by dividing the lined muffler cylinder with vertical metal baffles, as illustrated in Fig. 3.

The lining and baffles are composed of perforated sheet metal and sound absorbing felt and can be designed to absorb the prevalent frequencies generated. The height of the muffler, as well as the number and size of the baffles, is determined by the amount of reduction required, as well as the frequency spectrum of the exhaust noise. As the sound waves travel up the muffler, they are absorbed by the material and their kinetic energy of motion is converted to heat in the baffles and perforated lining.

In some cases, where the major portion of the noise is confined to a narrow peak at a given frequency, an acoustical filter system is incorporated into the muffler to eliminate this predominant pitch.

An approach to the problem of intake noise has been to enclose these intakes with a series of vertical perforated metal baffles perpendicular to the intake louvers. This forms a series of channels through which the air must pass to the intake louvers with very little restriction. Since the noise levels at the intakes are usually 10 to 20 decibels less than the exhaust, much less treatment is needed. Fig. 2 is a photo of a twin fan cooling tower atop a department store. The cylindrical mufflers can be seen above the fan throats and the intake silencing units on the lower left of the tower.

Before treatment, the store's air conditioning equipment had been shut down by a court order stemming from nearby tenants' complaints. With the equipment shut off, the store suffered a very definite loss in summer business. As a result of the acoustical treatment, the operating noise level was brought to within 2 decibels of the 80 decibel daytime ambient, and the injunction was subsequently withdrawn.

Noise "Radiation" from Sides of Tower

In most towers, silencing of exhaust and intake openings is sufficient to alleviate noise annoyance. However, in the case of some towers constructed of light gage metal, the noise radiation from the sides of the tower itself must be considered. This condition is very noticeable when the light side panel of the tower resonates at a frequency predominant in the noise spectrum generated within.

Tower noise radiation can be eliminated by stiffening and reinforcing these side panels and by dampening their vibration with a mastic and acoustical felt.

TOMORROW'S BUILDINGS MAY BE PRESSURIZED

TOMORROW'S BUILDINGS may be pressurized as well as scientifically heated and cooled, if progress in indoor climate control continues at its present pace, according to C. S. Koehler, of the Minneapolis-Honeywell Regulator Co., at a recent panel meeting on indoor climate control sponsored by the Producer's Council. He predicted that "we are going to see more emphasis on control of indoor climate than on any other phase of building design."

"It is conceivable we may soon have controls to regulate pressure in residential and commercial buildings," he said.

Protective Shelters in Modern Warfare

By Warren Viessman
Director, Heat & Power Div.
U.S. Naval Civil Engineering
Research and Evaluation Laboratory

Various air purification methods for wartime shelters are described. Particulate matter such as dusts, mists, bacteria and radioactive particles can be removed from the atmosphere by strainer and impingement filters, electrostatic filters, washers, ultrasonic agglomeration, and venturi-cyclonic scrubbers. The bacterial content within the enclosure can be reduced by means of glycol aerosols or by ultraviolet irradiation. Non-particulate matter, such as gases and vapors, can be removed by activated carbon adsorbers, washers and scrubbers. Filter and equipment performances and limitations are discussed, and some problems still to be solved are indicated. The selection of equipment depends on the design objectives, the type and size of the shelter, purpose, location, utilities available, nature and extent of probable attack and other military or civilian requirements.

THE SIMPLEST WAY to maintain clean, safe air within a shelter for the protection of personnel and material against various elements of modern military attack is to seal the structure against infiltration and leakage and avoid the introduction of ventilation air. While this procedure sounds simple, it cannot be carried out without some difficulty in practice, and if the shelter is to house personnel, outside ventilation air must be brought in or other means provided to avoid vitiation.

In practice, underground and surface shelters are sealed against leakage. All openings known to exist through which daylight may be seen or through which air enters are closed off, and small cracks around windows and defective places are sealed with bitumastic paste, film materials or industrial tapes.

For example, a quonset-type heavy corrugated steel shelter, as shown in Fig. 1, was sealed with battery sealing compound and industrial tape, as illustrated in Figs. 2-5. The only appreciable openings should be for ventilation air intake and exhaust and these are protected with dampers, relief valves (Fig. 6), filters, etc. In addition, the building must be pressurized to perhaps 0.6 in. of water in order to create exfiltration rather than infiltration through undetected cracks or faulty seals.

Air Locks and Decontamination

If personnel are to be permitted to enter the shelter during an attack, an outer and inner air lock must be provided which is swept with clean air from the shelter. Such an air lock is shown in Fig. 7. Decontamination facilities should also be provided, so that the exposed persons may remove their clothing in an undress room, take a thorough warm shower with plenty of water and soap [see Decontamination Procedures, The Effects of Atomic Weapons, Atomic Energy Commission, Supt. of Documents, Washington, D.C., Sept. 1950, 321], and dress in shelter clothing before entering the main waiting or work room space. Where the pressure of the shelter is 0.6 in., the shower and undress room would be 0.5 in., the inner air lock 0.4 in. and the outer air lock 0.3 in. Air thus flows from the main portion of the shelter through the undress and shower rooms to the inner air lock and then to the outer air lock, to be exhausted outside through a relief valve. This air flow is in the opposite direction to persons entering the shelter.

Air locks and decontamination compartments are usually made to accommodate two persons at a time, with the locks as small as practicable. Persons entering should remain in each lock for about three minutes. Ventilation air discharged outside through the lock described is about 200 cfm.

A quonset-type steel shelter 20 x 50 ft, such as that shown in Fig. 1 and suitable for 50 persons at rest, was found by test (Fig. 8) to discharge 200 cfm out through the air locks, about 200 cfm through leakage of the sealed structure, and 200 cfm through the relief damper, when the structure was pressurized to 0.6 in. with 600 cfm of outside cleaned air [see Temporary Protective Shelter — Construction and Performance Tests, by E. P. Donoghue and Warren Viessman, U.S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, Calif., 1950]. Recirculating air conditioning units are shown in Fig. 9, and an outside ventilation air intake filtering and adsorbing device is shown in Fig. 10.

Many Air Cleaning Devices Available

There are a number of filtering or air-cleaning devices available for filtering the ventilation air. None of them, however, can be said to give perfect results. A cleaning device must be selected with proper consideration given to the type of material to be removed, the efficiency of removal and other requirements based on local conditions. Military necessity in the theater of operations may be greater than for industrial

plants at less susceptible locations.

Dry strainer-type filters are employed in ventilating, heating and air conditioning systems where dust contents seldom exceed 4 grains per 1000 cu ft. This concentration is equivalent to what might be reasonably expected in fairly dusty factories. These dry filters are usually of the replacement or throwaway type. Efficiencies depend upon the nature of the dust and the air velocities, the highest efficiencies being obtained at low velocities of about 5 fpm through the filtering medium.

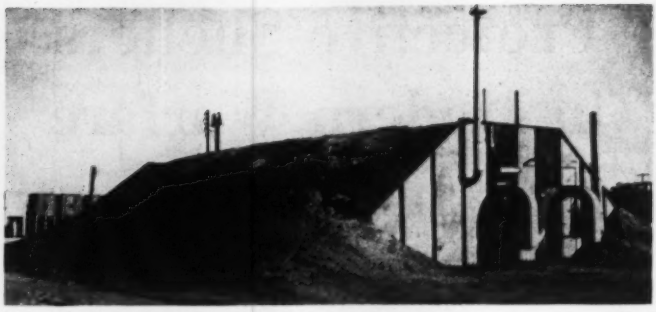
For heavier dust loadings, viscous impingement filters are available. This type of filter is coated with a viscous oil which collects particulate matter as the air passes through the filter. Filter efficiencies depend upon the construction, the dust specification and the air velocity. Velocities from around 300 to 800 fpm are prevalent.

Electrostatic filters are made in automatic cleaning types and cell types, both of which are usually equipped with viscous oil coatings on the plates similar to that used by impingement filters. Dry-type electronic filters containing cellulose filter sheets are also available. The automatic electronic filter has the highest efficiency of the three types of filters for the removal of particulate matter.

Washers using water sprays without recirculation are effective in the removal of particulate matter such as dusts, smokes, mists and bacteria. Non-particulate gases and vapors can perhaps be more effectively removed by soda spray solutions in lieu of water sprays.

Activated Carbon Adsorbs Gases

Many gases in the atmosphere can be adsorbed by charcoal. Charcoals differ widely in the adsorption capacities. Those which have marked adsorption characteristics are sometimes called "activated charcoals" or "activated carbon". These materials can adsorb up to 45 percent of their own weight of an organic gas at 70 F. Adsorbers are available with various carbon bed thicknesses. In industrial and commercial applications, they can be reactivated at temperatures above 1000 F. In military operations, they are discarded when their adsorptivity



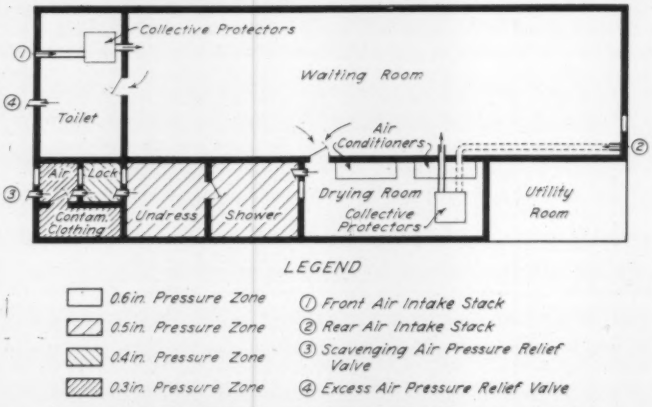


FIG. 1 — QUONSET-TYPE steel shelter, with all openings sealed to prevent infiltration of untreated air

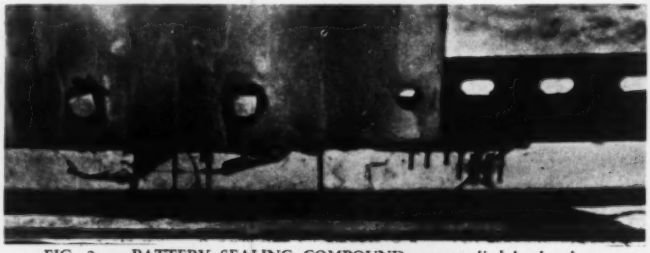


FIG. 2 — BATTERY SEALING COMPOUND was applied by brush to seal between the base angle and arched ribbed section of the shelter

FIG. 3 — SEALING COMPOUND was also used between the joints of the arched rib sections of the quonset-type shelter

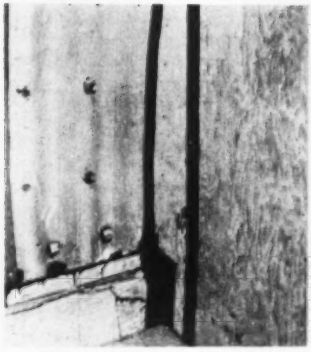


FIG. 4 — PRESSURE SENSITIVE TAPE was used for sealing the joints between plywood panels and the corrugated steel shell

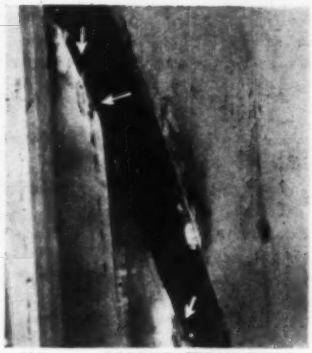
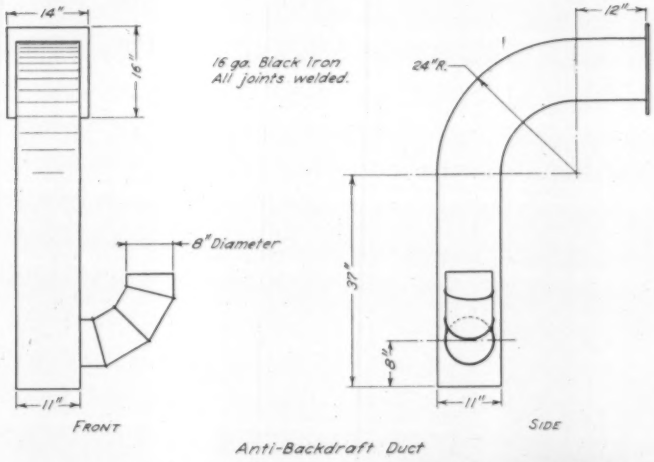
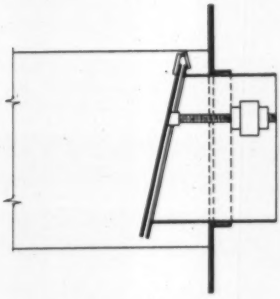


FIG. 5 — CORRUGATIONS WERE FLATTENED (see arrows) to make tighter seal in joint between rear bulkhead and shell





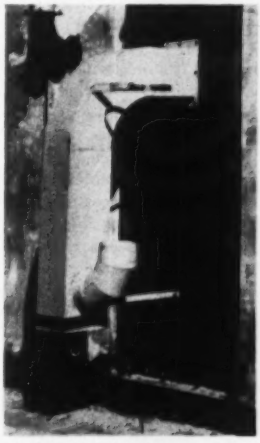


FIG. 6 — ANTI-BACKDRAFT DUCT as used in the shelter illustrated in Fig. 1. Building is pressurized to create exfiltration

reaches a safe limit or at the end of an attack. Carbon adsorbers are not used for the removal of particulate matter.

Ultraviolet Radiation

In the event that commercial-type filters are employed for industrial personnel shelters, some small particles, viruses and germs are expected to pass through the filter. In case of biological attack, this might cause casualties. The situation can perhaps be relieved somewhat by the installation of ultraviolet irradiation equipment. Such equipment has proved valuable in hospitals, food preparation plants and other types of buildings.

Decrease in the bacteria count may vary from 33 to 97 percent, depending on the germ or virus, the conditions, the equipment and method of installation. The positive effect of ultraviolet light on the destruction of the influenza virus has been well demonstrated. The design which yields the highest average intensity per unit of ultraviolet light radiated into the room will generally accomplish the most disinfection per unit intensity.

Ultraviolet radiations employed in sanitary ventilation are usually produced by an electric discharge through mercury vapor contained in an envelope transparent to radiations of 2537 angstrom units. Radiations at this wave length which are lethal to bacteria will also produce skin erythema and eye discomfort. The energy required for uniform radiation at this wave length varies with humidity, best results being obtained at relative humidities below 50 percent.

Manufacturers provide designs which will protect personnel from the direct rays, when properly installed. The minimum mounting height is 7 ft. Water paints and papers having high reflectivity for ultraviolet at 2537 angstroms should be avoided. Lamps can also be placed in the air ducts and danger to personnel minimized, but more lamps are required for installations of this type.

Glycol Vapors for Disinfection

Another means of disinfecting air is by use of propylene or triethylene glycols as aerosols. Various

FIG. 7—LOOKING INTO INNER AIR LOCK from shelter's undress room, showing air regulator valve and doors between air locks

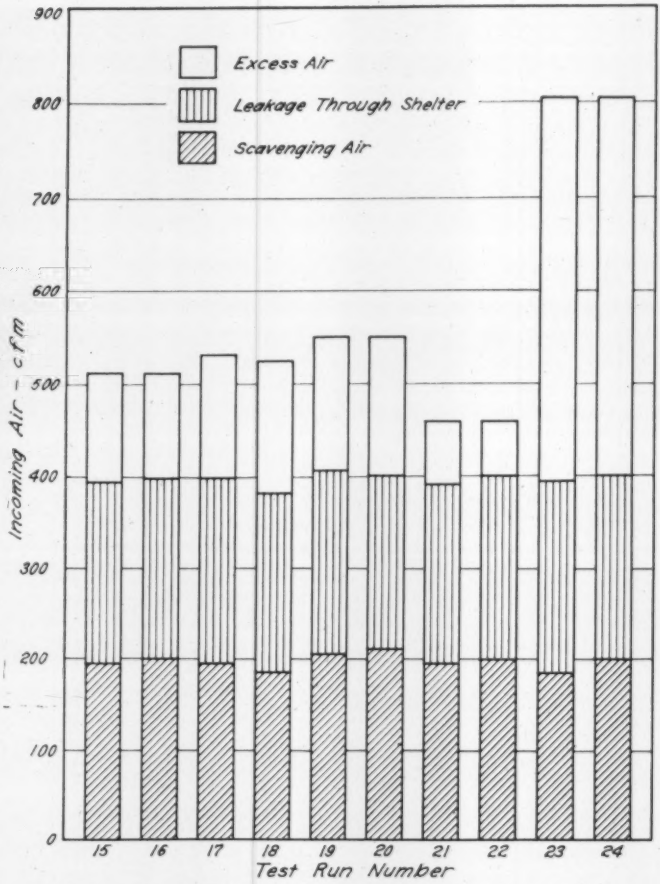


FIG. 8 — DISTRIBUTION OF INCOMING AIR to shelter with earth fill cover, as indicated by series of test runs

vapor generators are available. The aerosols are lethal to most airborne bacteria and viruses under favorable conditions. They have low toxicity, low surface tension (and therefore can be readily divided into fine mists) and have good bactericidal activity. If the air is cold and dry or excessively humid, the effectiveness is reduced. Relative humidities of around 45 percent are desirable at 76 F. Under favorable conditions, the bacterial count can be reduced 90 percent. One gram per 5,000,000 cc of air is considered an effective concentration, although protection as determined by colonies on settling plates has been obtained against streptococcus with 1 gram of triethylene glycol per 100,000,000 cc of air, and against pneumococcus with 1 gram per 200,000,000 cc. Complete protection has been afforded mice against airborne influenza virus with a concentration of 1 gram per 200,000,000 cc of air.

Sonic Agglomeration

Considerable investigation has been made into the use of sonic and ultrasonic means to agglomerate microscopic and submicroscopic particles into larger masses for separation out of a gas or air stream. In some cases, the work was done as a matter of air cleaning, or removal of atmospheric pollution and in others, it has been inspired by the possibility of the recovery of valuable chemical elements. Sound waves for this purpose can be produced by a variety of generators. Frequencies up to several hundred kilocycles have been used, depending on the application. Particle agglomerate sizes have been increased a hundredfold in the sound field. Most successful results for particulate matter in air, or gases, have been obtained at about 4 kc, and for germs in liquids at about 9 kc. Actually, these frequencies are within the audible range for most persons, which is 20 to 20,000 cycles. An intensity of 150 to 165 db is usually required. This is within the threshold of feeling.

The particulate-laden air is fed into a sound chamber attached to the resonator and tuned to resonate with it. The flocculated particles leave with the air, are separated in a cyclonic or other separator, and either the particles, or cleaned air, or gases are recovered. A sonic collection installation is diagrammed in Fig. 11. Industrial installations with equipment of this type have been made for the recovery of soda ash fume, sulphuric acid fog and carbon black. A pilot installation has been made for the flocculation of ammonium chloride smoke. The sulphuric fog installation was for a gas stream of 24,000 cfm, with particles from 0.5 to 5 microns. The soda ash installation was for 50,000 cfm, with particles leaving the furnace averaging less than 1 micron.

The effect of sound on bacteria cannot be depended on, as some types seem unaffected, while others

are affected only at certain frequencies that are undesirable for other matter. Since bacteria are particulate substances, they would be removed by such equipment, although perhaps not destroyed.

The whistle-type sonic generator, Fig. 12, depending on the interrupted air stream method, is available for gas flows up to 50,000 cfm for an individual unit, and requires about 10 kw for the air compressor and sound generator motor. Frequencies from 500 to 22,000 cps at intensity levels up to 165 decibels above a level of 0.002 dynes per sq cm are available.

While this type of removal equipment will handle large air volumes for industrial installations, it does not appear to have dependable efficiencies over about 85 percent. This is not good enough for military purposes in the theater of operations, but could have some application for large installations in remote locations, or where backed up by fine strainer filters. It is effective for particulate solid and liquid matter. The efficiencies will be affected by the materials to be handled and the design of the installation. If the particles are not of sufficient density to cause effective agglomeration by collision, the system may have to be loaded by the addition of other particles.

Venturi and Cyclone Scrubbers

Where water or other suitable liquid is available and large quantities of air or gas are to be cleaned, a venturi scrubber, a cyclonic scrubber, or a combination venturi-cyclonic scrubber could be used.

In the venturi scrubber, the gas enters a venturi nozzle equipped with a water or liquid spray at the throat. Air usually travels between 200 and 400 fpm through the throat, and liquid flow is adjusted between 3 and 9 gal per 1000 cu ft. After passing through the throat, the mixture of gas and liquid enters a cyclonic separator, the liquid and contaminants are drawn off the bottom, and the clean air swirled around and drawn out the top by a fan.

On a test made for the recovery of iron oxide, with particle sizes from 0.02 to 0.50 microns, and inlet dust loadings in grains per cu ft from 1.0 to 6.0, the exit dust loading was 0.010 to 0.070 grains per cu ft. Sulphuric acid mists and fogs scrubbed with water and having an inlet loading of 303 milligrams per cu ft had an exit loading of 1.7.

The cyclonic scrubber, with liquid sprays within the cyclone, has also given high efficiencies. Iron ore and coke dust having a particle size from 0.5 to 20.0 microns and an inlet loading of 3.0 to 24.0 grains per cu ft had an exit loading of 0.03 to 0.08. For fluorine mist, with an inlet loading of 312 milligrams per cu ft, the exit loading was 7.2.

For a combination of the venturi and cyclone, scrubbing in both, with sulphuric acid mist, the inlet loading was 283.0 milligrams per cu ft and the exit loading 1.06 milligrams per cu ft.

Selection of Air Cleaning Methods

Is is evident that many arrangements can be made to clean the incoming air to a shelter or increase

FIG. 9—TWO AIR CONDITIONERS of 47,000 Btu and 800 cfm capacity supply recirculated air to the shelter waiting room

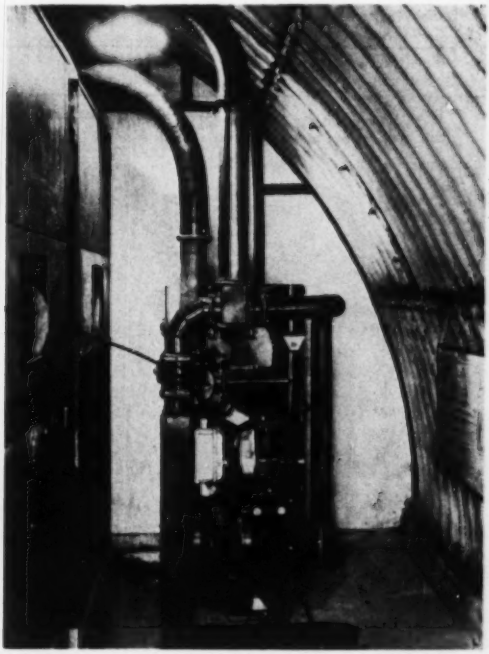


FIG. 10—INTAKE FAN, FILTER AND ADSORBER equipment installed in shelter is electric motor or engine driven. Capacity is 300 cfm

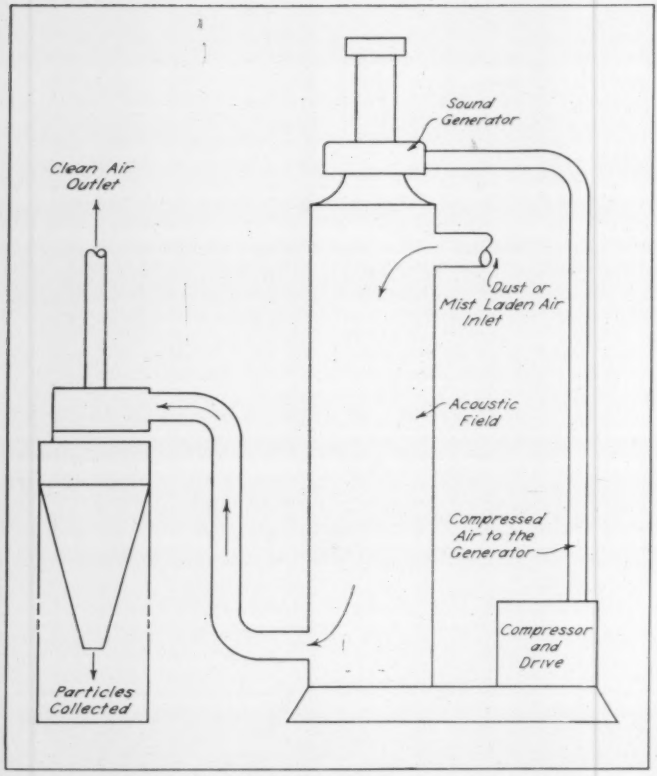


FIG. 11 — SONIC COLLECTION system installation. Sound waves for this purpose can be produced by various types of generators

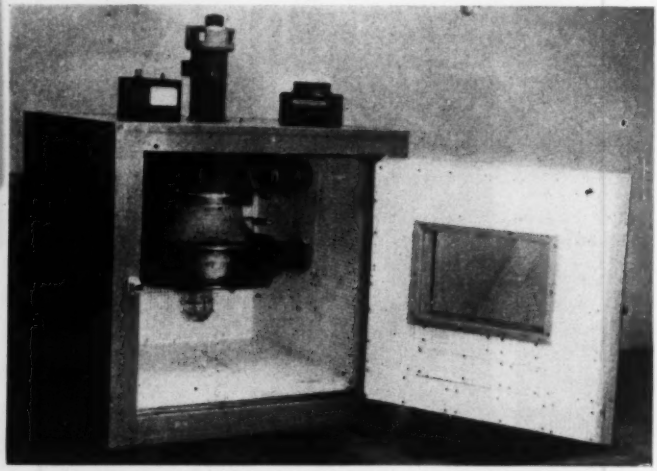


FIG. 12 — WHISTLE TYPE SONIC GENERATOR in sound absorbing compartment, with capacity to treat 1500 cfm of air

its purity within the shelter. In each case, a design objective must be established. For military purposes, it is probable that protection will be desired against chemical, biological and radioactive contaminants in the atmosphere. The degree of protection desired must also be considered. For small military structures likely to be subjected to the greatest hazards, the maximum possible protection may be desired. In this case, the most efficient strainer filter in combination with a specially-developed activated carbon adsorber might be selected. Filter frame construction and duct work must be airtight and the building properly sealed and pressurized, or the advantage of filter performance will be lost. The shelter must also be equipped with air locks and decontamination equipment to permit entrance during attack.

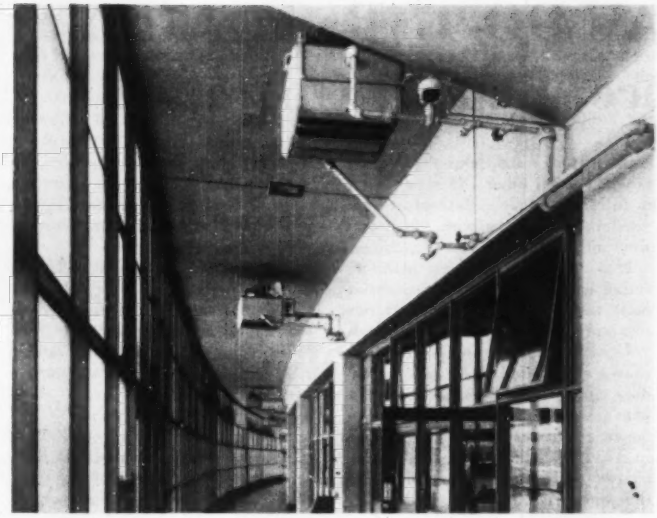
For large industrial establishments, more remote from danger, perhaps electronic precipitators backed up by strainer filters would be the economical solution and afford the protection desired. Still larger installations may find a sonic or scrubber-type installation preferable.

The availability of dependable utilities, such as water and electricity, also has an important bearing on the problem. In each case, the designer must make the best application of the available equipment consistent with the conditions.

It is realized that there are limitations in the performance and application of presently available equipment and methods. However, suitable equipment can be obtained to assure reasonable protection.

Future research on shelter construction, sealing materials and methods, decontamination procedures and air purification is expected to improve greatly protection for a wider range of applications.

[Figs. 1 to 7 inclusive and 9 and 10 are official U. S. Navy photographs. The author used a number of references in textbooks, professional journals and manufacturers' publications in preparing his material on methods of air cleaning, sterilization and adsorption. In his article in the March HPAC, Mr. Viessman pointed out that protection against atomic attack involves blast, heat and radiation and gave information on this and on chemical and biological attack.]



3053 FT LONG CORRIDOR at the Logan international airport, Boston, showing some of the vertical shaft propeller fan unit heaters which keep it comfortable

Units Heat Big Airport Building

HEATING THE largest airport passenger terminal in the world has proved to be "a routine assignment" for 104 unit heaters installed in the big General Louis E. Boutwell building at Logan international airport, Boston.

These heaters maintain uniform comfortable temperatures by distributing 9,250,000 Btu to heat a building 3053 ft in length.

The building area, which overlooks the ocean, is 160,000 sq ft, constructed in the shape of a huge "W". Twenty thousand panes of glass adorn the terminal.

Built on "made" land — 55 million cu yd of fill, 40 million of which were pumped from the ocean bottom — the Boutwell building incorporates a continuous corridor on the interior side of the "W" connecting the 16 airline terminal offices and loading stations.

This continuous corridor, 3053 ft long and with one wall entirely of glass, is heated by 60 vertical shaft propeller fan unit heaters, each delivering 1120 cfm and 93,950 Btu per hr. These units are equipped with two-way adjustable, louvered type air diffusers, discharging warm air parallel to the passageway.

Twelve additional propeller fan units are used in storage, baggage and express areas. Each is controlled by a gradual acting room thermostat, a gradual acting steam coil valve and a pneumatic electric switch. In operation, the thermostat closes the pneumatic steam coil valve and the electric pneumatic switch shuts off the unit heater motor.

The 16 large triple-loading area doors that open onto the apron and airplane loading docks are blanketed by 32 cabinet type unit heaters. These units kill the chilling drafts that would otherwise enter the open doors during loading. Each of these heaters is operated by a remote bulb, gradual acting temperature controller with its sensitive element located on the back of the air inlet grille, and a gradual acting coil steam valve.

Thermostatically controlled to take advantage of the sun effect on the large glass area, the 104 unit heaters have been heating the building uniformly, effectively and economically for 18 months. Of particular advantage in this installation, no valuable floor space is used, since the units are ceiling and wall mounted. Floors thus present an unobstructed surface for cleaning equipment and the handling of baggage.

All unit heaters in the Boston airport terminal building are readily accessible for maintenance. The pleasing appearance of the hard-baked enamel cabinet finish adds to the interior decoration.

In determining the heat load of the large, narrow, unusual structure, 0 F temperature and average wind velocity were used as outside weather conditions and 60 F was the design temperature. Five pounds steam pressure is supplied to all units with gravity return to an open receiver and thermostatically controlled pneumatic valves and electric switches govern the steam and electric supply to the radiators and motors respectively.

The architects were Coolidge, Shepley, Bulfinch & Abbott; the consulting engineer was Thompson & Lichtner Co., Inc.; the mechanical engineer was the Office of Hollis French; and the heating contractor was the Cleghorn Co.—ROBERT E. REED and ROBERT F. DELAY, Herman Nelson Div., American Air Filter Co.

PAYS $21,746 FOR BUILDING PERMIT

THE PRUDENTIAL Insurance Co. paid a fee of $21,746 to the Chicago building department last month for a permit to build a proposed 35 story skyscraper near the "loop" area. Volume of the building, according to Naess & Murphy, the architects, will be 20,624,708 cu ft, although detailed drawings won't be ready for a year or so.

The ventilation fee — based on an average of $3 per 1000 cfm of air supplied to or exhausted from the building — amounted to over $1500.

Using NPA's DO-97 Ratings for Maintenance, Repair, Operation

A PROGRAM "to maintain at peak efficiency the nation's existing equipment for the production of goods and services" was announced last month by the National Production Authority, U. S. Department of Commerce, with the issuance of NPA regulation No. 4 which provides a DO-97 rating for maintenance, repair and operating supplies. Under this program, all establishments in the United States — warehouses, factories, retail and wholesale stores, service shops, farms, hospitals, schools, libraries, churches, federal, state and local governmental agencies — may, when necessary, use a priority rating to procure equipment and supplies for maintenance, repair and operation of present facilities.

The regulation is "permissive" in character. No one is required to use the ratings assigned to purchase his MRO supplies but if he does so he becomes bound by the limitations of the regulation.

The regulation permits application of the DO-97 rating by business concerns and other institutions without individual authorization by NPA. The rating may be used solely to acquire maintenance, repair and operating supplies and may not be used to purchase production material (i.e., material or components to be incorporated in end products) nor to purchase major capital items. The rating is equal to all other DO ratings and is fully extendible. Ratings are applied in accordance with the provisions of NPA regulation No. 2.

THE ORDER permits all business enterprises to use a DO-97 rating to obtain needed maintenance, repair and operating supplies

If a concern elects to use a DO-97 rating even on a single occasion, it must then limit its MRO purchases in accordance with regulation No. 4.

Under the regulation, MRO purchases are limited in any one calendar quarter to one-fourth of the firm's dollar purchases for maintenance, repair and operating purposes in 1950 (or the fiscal year ending nearest to December 31, 1950). If this quota is too small to provide sufficient MRO supplies, the firm may file with NPA an application for an increased quota.

To provide for seasonal businesses, the new regulation permits quarterly MRO quotas equal to the amount spent by the business for MRO in the corresponding quarter of 1950 (or fiscal year).

Businesses which were in operation only a part of 1950 are permitted a quota in proportion to the amount they spent for MRO while they were in operation, with reasonable adjustments for seasonal and other variable factors. New firms started after December 31, 1950, are permitted to acquire for MRO purposes the minimum amounts necessary for operation, up to $5000 a quarter. They must obtain special NPA authorization for MRO expenditures above this amount. When the quarterly quotas for these businesses exceed $1000, the NPA must be informed in writing of the base period used, the reasons for selecting it, and what adjustments have been made.

Small businesses are permitted to extend DO-97 ratings for MRO purchases up to $1000 a quarter, without regard to the quota restrictions. All other firms making MRO purchases under DO-97 ratings are required to follow the procedures established in the regulation for figuring their quotas.

In all cases where DO-97 ratings are used to procure MRO supplies, the firm is required to charge against its MRO quota purchases made without use of the rating.

The DO-97 priority rating may be applied to non-rated MRO orders now outstanding.

The new regulation replaces the amendment to NPA regulation No. 2, issued January 11, which permitted manufacturers working on defense orders to procure under ratings jigs, dies, tools and fixtures where necessary to meet delivery dates established in rated orders.

Supplements to the regulation will be issued from time to time, NPA said, making further provisions for MRO materials for industries such as mining, transportation and others, which because of the nature of their operations require special handling of MRO items.

Questions and Answers on MRO Order

1) *Q. What is the purpose of NPA regulation No. 4?*

A. Its purpose is to provide a ready means whereby all business establishments and other non-business institutions — large and small — may when necessary use a priority rating to obtain supplies and materials they require for maintenance, repair and operating supplies.

THE NPA PERMITS use of the DO-97 rating for minor capital additions not exceeding $750 for any one complete capital addition

2) *Q. Why is this regulation necessary?*

A. One of the basic aims of the National Production Authority is to

maintain the nation's production to strengthen its defenses. This makes it imperative that existing facilities and equipment be maintained in top working condition.

3) *Q. How does this regulation accomplish this purpose of maintaining present production facilities?*

A. It permits all business enterprises, large or small, whether engaged in retail or wholesale trade or in manufacturing, to use an extendible DO-97 rating to obtain needed maintenance, repair and operating supplies (MRO).

4) *Q. What is meant by "extendible DO-97 rating?"*

A. Under NPA's basic priorities system, certain essential production

TO USE THE rating, a businessman writes on his order, or on a piece of paper attached to it, these words: "DO-97, Certified under NPA Regulation 4", and then signs his name

is given preference. "DO-97" is the preference symbol assigned by NPA for use on orders for maintenance, repair and operating supplies. This preference rating may be extended by the person receiving the rated order in the same way as any other DO rating may be extended.

5) *Q. Is there any special significance to the number "97"?*

A. The number is used for identifying the MRO program, just as other programs are identified by a two-digit number. There is only a single-band priorities system, which means that all orders with a priority rating, regardless of the program identification number, receive equal treatment.

6) *Q. What about other organizations, such as schools, hospitals, churches and government agencies?*

A. Regulation No. 4 includes them, too. Federal, state, municipal and other governmental units may use the DO-97 rating and so may schools, libraries, churches, hospitals and similar institutions.

7) *Q. Does the regulation exclude any type or types of institutions?*

A. No. All institutions in the United States and its possessions and territories when necessary may use DO-97 ratings to get the maintenance, repair and operating supplies they require.

8) *Q. Is any special authorization required from NPA for the use of the rating?*

A. No. The regulation is self-explanatory and the rating may be used by any concern in accordance with regulations Nos. 4 and 2.

9) *Q. Is there any limitation on the amount of these supplies a business or institution may obtain?*

A. Yes. In general MRO supplies may be obtained only in the same dollar amount spent for such supplies during 1950.

10) *Q. Must MRO quotas be figured on a quarterly basis?*

A. That is right. Businesses, government agencies and institutions simply divide the amount they spent for MRO in 1950 by four and that is their quarterly quota.

11) *Q. Is any provision made for seasonal business?*

A. Yes. A business or institution that desires to do so may take as its quarterly MRO quotas the amounts spent for MRO in the corresponding quarters of the calendar year 1950.

12) *Q. How does a new business establish its MRO quota?*

A. If it was in operation during part of 1950 it is permitted a quota in proportion to the amount spent while it was in operation, with reasonable adjustments for seasonal and other variable factors.

13) *Q. What about new firms started during* 1951*?*

A. They are permitted to acquire for MRO purposes the minimum amounts necessary for operation, up to $5000 a quarter. They must obtain special NPA permission for MRO expenditures above this amount. When the quarterly quotas for these businesses exceed $1000, the NPA must be informed in writing of the base period used, the reasons for selecting it and what adjustments have been made.

14) *Q. Many firms operate on a fiscal year rather than a calendar year basis. How do such firms determine their quarterly MRO quota?*

A. Any firm or institution may, if it wishes, use its fiscal year rather

ALL PERSONS using the DO-97 rating must keep complete records and preserve them for the duration of the regulation and two years thereafter

than the calendar year in establishing its quota.

15) *Q. Is a business firm or other institution required to use a DO-97 rating to acquire the MRO supplies it needs?*

A. No. MRO may be obtained without using the DO rating. But if a person does make use of this rating, then his total acquisition of MRO, both rated and unrated, becomes subject to the quarterly limitations of the regulation.

16) *Q. May a small businessman — say the owner of a shoe repair shop or a filling station — issue a DO-97*

WHAT "DO" RATINGS MEAN

The DO rating system is a single-rating band, and National Production Authority regulations require that all DO-rated orders be filled in advance of non-rated orders. Many materials and products needed for the defense program are in short supply, and the purpose of the single-band priorities system is to assure that defense and defense-supporting production has the right of way.

The code numbers assigned to the various DO ratings are purely for purposes of identifying the program to which the order is related, or the claimant agency, and do not indicate any preference. Rated orders are to be accepted in the order in which they are received. Thus, the DO-97 rating identifies the order with the NPA or its delegatee, and as an order for maintenance, repair and operating supplies.

to obtain the supplies he needs to maintain his business and equipment in good condition?

A. Certainly.

17) *Q. What does he have to do to use such a rating?*

A. He merely writes on the order, or on a piece of paper attached to it, these words: "DO-97, Certified under NPA Regulation 4," and then signs his name.

18) *Q. Does such a DO-97 carry the same priority value as other DOs, those issued by the armed services, for instance?*

A. Yes, since all DO ratings have the same priority value.

19) *Q. Suppose the operator of a furniture repair shop needs to get some sandpaper and hand tools. May he issue his own DO-97 to obtain these supplies?*

A. Yes.

20) *Q. After he has used a DO-97, what else must he do?*

A. If he uses more than $1000 worth of MRO per quarter, he must record the expense as a charge against his MRO quota, but if he uses less than $1000 of MRO per quarter he need only keep a record of the transaction.

21) *Q. Does every firm or institution using DO-97s have to keep records of its MRO purchases?*

A. Yes. The NPA requires that all persons using the DO-97 rating must keep complete records and preserve them for the duration of this regulation and two years thereafter.

22) *Q. Is any particular accounting system required in these records?*

A. No. Any system is satisfactory, provided that it will disclose the information needed by the NPA for an adequate audit.

23) *Q. Is there any provision in the regulation for minor capital additions?*

A. Yes. NPA permits the use of the rating for minor capital additions not exceeding $750 for any one complete capital addition.

24) *Q. Can an example be given showing how this provision might work?*

A. Yes. Suppose a shoemaker needs a new leather stitching machine. He may obtain the machine under a DO-97 rating, providing it does not cost more than $750.

25) *Q. Is any provision made for quota adjustments?*

A. Yes. Any person may at any time file with NPA a request for adjustment on the ground that his MRO quota is not sufficient for his requirements, or that it works an undue or exceptional hardship on him not suffered generally by others in the same trade or industry, or that its enforcement against him would not be in the interest of national defense or the public interest.

26) *Q. Suppose a firm has been granted an increased quota for MRO. Must it make a new application for each succeeding quarter?*

A. No. Once an increased quota is established, this becomes the firm's standard quota, unless the increase was granted on a temporary or seasonal basis, or is otherwise restricted by NPA.

27) *Q. Many firms have already placed non-rated orders for MRO supplies. May these firms now apply DO-97 ratings to them?*

A. Yes. All ratings applied on or after March 15 shall take effect as of the dates when applied.

28) *Q. What if a machine repair shop is hired by the proprietor of a shoe shop to repair a machine. To whose quota are the repair parts used on this job charged?*

A. The machine repair shop may use a DO-97 rating to the same extent that the shoe shop proprietor would be permitted to use it if he himself were repairing his own machine. The cost of the materials is charged to the MRO quota of the person for whom the work is done — in this case the shoe shop proprietor.

29) *Q. Suppose a home owner needs to obtain repair parts for some equipment in his home. May he also make use of the DO-97 rating?*

A. No. The rating may not be used to obtain materials for personal or household use.

SYMBOLS FOR DO ORDERS LISTED BY NPA

THE NATIONAL PRODUCTION Authority of the U. S. Department of Commerce issued last month a list of DO (defense order) symbols used for rating orders for production under the mobilization program. The system is a single-rating band, and NPA regulations require that all DO-rated orders be filled in advance of non-rated orders. The code numbers are purely for the purpose of identifying the program to which the order is related, and do not indicate any preference.

List of DO order symbols, subject to change from time to time

DO CODE NO.	AGENCY PROGRAMS	MAJOR PROGRAM INVOLVED
01	Department of Defense	Aircraft
02	" "	Guided Missiles
03	" "	Ships
04	" "	Tank-Automotive
05	" "	Weapons
06	" "	Ammunition
07	" "	Electronics and Communications Equipment
08	" "	Fuels and Lubricants
09	" "	Clothing and Equipage
10	" "	Transportation Equipment
11	" "	Building Supplies and Equipment For Overseas Construction
12	" "	Subsistence
19	" "	Production Equipment
21	" "	Miscellaneous
22	" "	Contract Construction
35	Economic Cooperation Adm.	Foreign Additional Military Production
36	" "	Foreign Non-Military Production
37	Office of International Trade	Foreign Production (other than E. C. A. Non-Military)
40	Atomic Energy Commission	Operations
41	" "	Construction
42	" "	Construction Equipment
43	" "	Privately Owned Complete Facilities
44	" "	Privately Owned Facilities Additions
45	National Production Authority, Civil Aeronautics Adm. and National Advisory Committee for Aeronautics	Miscellaneous
46	National Production Authority	Industry Plant Expansion
47	" "	All Canadian Programs
48	Department of Interior	All Programs
49	Department of State	Voice of America
60	U. S. Coast Guard	Miscellaneous
61	" "	Aircraft
62	" "	Construction
63	" "	Ships
97	National Production Authority (or delegatee)	Maintenance, Repair and Operating Supplies
98	National Production Authority (or delegatee)	Production Equipment for Certain Private Contractors
99	National Production Authority (or delegatee)	Basketing (Small orders bunched together under NPA Reg. 2)

(Digits 50 and 51 were formerly used by the National Advisory Committee for Aeronautics. Digits 55, 56 and 57 were formerly used by National Production Authority for Canada).

New Sun Angle Calculator Simplifies Solar Engineering

By Donald W. Dunipace

THE HISTORY OF WINDOWS is essentially the story of man's progress in combining the beauty and light of the out-of-doors with the comfort and shelter of interiors. The course of this evolution includes the development of glass itself, improvement of manufacturing methods to produce large clear glass areas on a mass production basis, development of double glazing to permit the use of more and larger windows without objectionable heat losses, and the advancement of architectural and engineering design to utilize the advantages of large windows while minimizing the disadvantages which might otherwise occur.

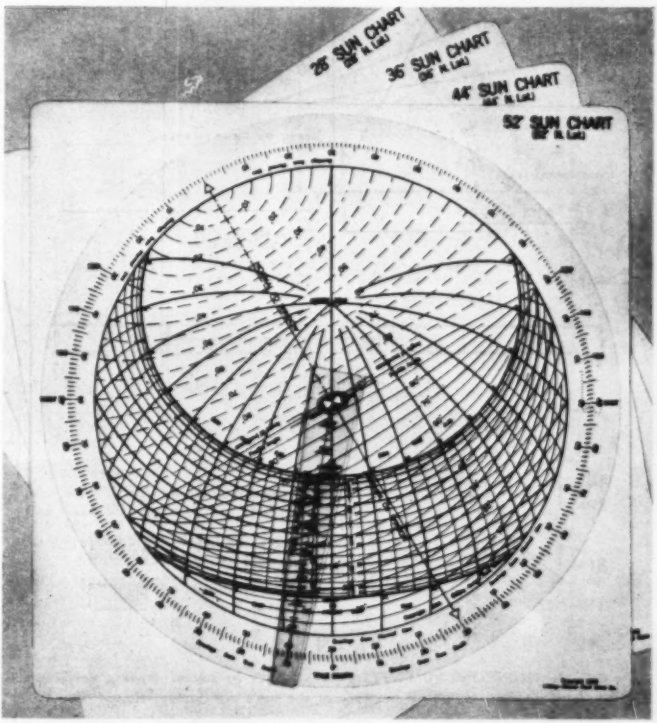
The importance of architecture and engineering in the use of windows may be illustrated by a simple example. A large single glazed window facing south would bring outdoor beauty and light indoors but at the expense of excessive heat loss on cloudy days and at night during cold weather and excessive radiant heat gain on sunny summer days. These disadvantages can be readily overcome by the use of a double glazed window combined with properly designed overhang or shading devices.

Although it is primarily the responsibility of the architect to take into account the effect of the sun in his creation of an architectural design, it is also apparent that the orientation of the building and the arrangement of windows or shading devices are of considerable interest to air conditioning and heating engineers. The effectiveness of the cooling equipment depends upon having it large enough, and the economy of the installation upon not having it too large. Thus, engineers need to know how much heat, including radiant energy from the sun and sky, must be dissipated.

Many methods have been employed to estimate solar heat gain through glass, most of them involving reference to several tables or use of trigonometric processes. Such methods, in order to give estimates sufficiently accurate for engineering purposes, have been laborious and time-consuming. Consquently, it is frequently impractical to compute the solar heat gain for a sufficient range of conditions. Furthermore, the relatively high number of steps involved increases the possibility of error.

Both of these difficulties have been largely overcome by the Sun Angle

FIG. 1—NEW SOLAR calculator consists of charts for various latitudes with transparent overlay and cursor making it possible to read the angles directly



Mr. Dunipace is a physicist with the technical development dept. of the Libbey • Owens • Ford Glass Co. He is a member of the American Physical Society, the Optical Society of America and the American Association for the Advancement of Science. He has published several papers, including Solar Position Calculator, in Physics Review. Mr. Dunipace took a major part in developing the sun angle calculator he describes here.

Calculator which has just recently become available to engineers and architects. This instrument, Fig. 1, consists of a series of base charts, one for each 4 deg of latitude from 24 to 52 deg north inclusive, which show the positions of the sun at intervals of every 20 min during the day for three days of each month of the year. Sun positions for intervening days can be found by interpolation.

Finding Solar Angles

A transparent overlay and cursor make it possible to read directly the true altitude, azimuth (bearing) and the angle of incidence of the sun with respect to a vertical wall or window for any sun position. In showing the position of the sun with reference to a wall on a vertical sectional drawing, the true altitude angle can be used only when the sun is on a line exactly perpendicular to the wall. When the sun is in any other position, it would be necessary to make a projection of the true altitude angle upon a plane perpendicular to the wall. To eliminate this process, the calculator gives directly a fourth angular value called the profile angle which is actually the projection just mentioned.

Another important feature of the calculator is the fact that direct readings for the four solar angles can be made for a window facing in any of the 360 deg of the compass.

In short, all of the angular values of the sun's position necessary for building designing and for estimating solar heat gain through the glass can be obtained from the calculator in a few minutes without computations of any kind.

Designing Shading Devices

Of no less interest to the architect or engineer is the instruction booklet which accompanies the calculator. In addition to explaining how to operate the calculator, the booklet explains how to determine the positions and dimensions of overhead and lateral sun control devices, how to find the depth and extent of penetration of the sun's rays through windows, how to arrive at the area of glass which will be irradiated or shaded and how to estimate the solar heat gain through the glass.

The "drafting board," rather than the mathematical, approach is used in the booklet in dealing with the problems of shading and solar heat gain. Accordingly, angular values from the calculator are laid off on scaled sectional and plan drawings so that desired dimensions can be obtained with a scale rule. An example in point is Fig. 2. After profile angles of the sun's positions on selected design days and hours have been laid off on a scaled vertical section, the necessary width of the roof overhang and the depth of penetration by the sun's rays can be scaled. These dimensions can be computed, but scaling is quicker and easier and is usually accurate enough.

A similar method is explained, by drawings and text, for obtaining the length of a horizontal overhead sun shade and how the dimensions and locations of lateral shading devices (vertical fins, plantings, etc.) are found.

Determining Shading Areas

The design of shading devices is, of course, an architectural responsibility. But engineers will be especially interested in another section of the booklet. This deals with the shadows cast by various types of shading devices.

Fig. 2 indicates how the extent of shadows caused by overhead projections may be determined. The horizontal extent of shadows cast by lateral shading devices is illustrated by another drawing reproduced from the booklet and relabeled

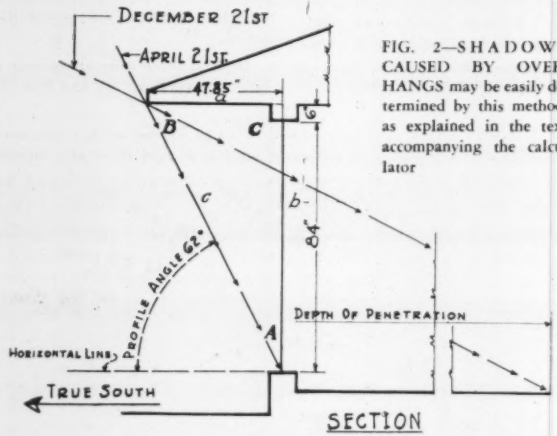


FIG. 2—SHADOWS CAUSED BY OVERHANGS may be easily determined by this method, as explained in the text accompanying the calculator

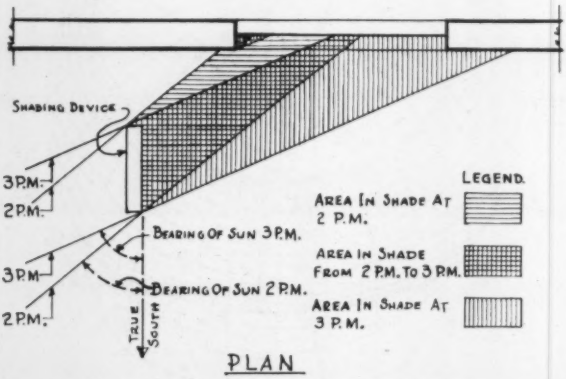


FIG. 3—HORIZONTAL EXTENT of shadows by lateral shading devices is determined by laying off bearings of the sun's position at selected design hours, as indicated here

Fig. 3. In this instance bearings of the sun's positions at selected design hours are found by using the calculator and are laid off on a plan drawing as shown.

Similar drawings, this time in vertical section, show how profile angles obtained from the calculator for selected design hours are laid off to indicate the vertical extent of the shadow on the wall. It is pointed out that an elevation drawing developed from the plan and sectional drawings will indicate the areas of wall or window which will be shaded or irradiated. Shadows cast by window reveals are determined in the same manner.

Of greatest interest to the air conditioning and heating engineer will be the section of the booklet devoted to estimating solar heat gain through glass. It is a new approach which reduces the paper work to a few steps in simple multiplication and addition.

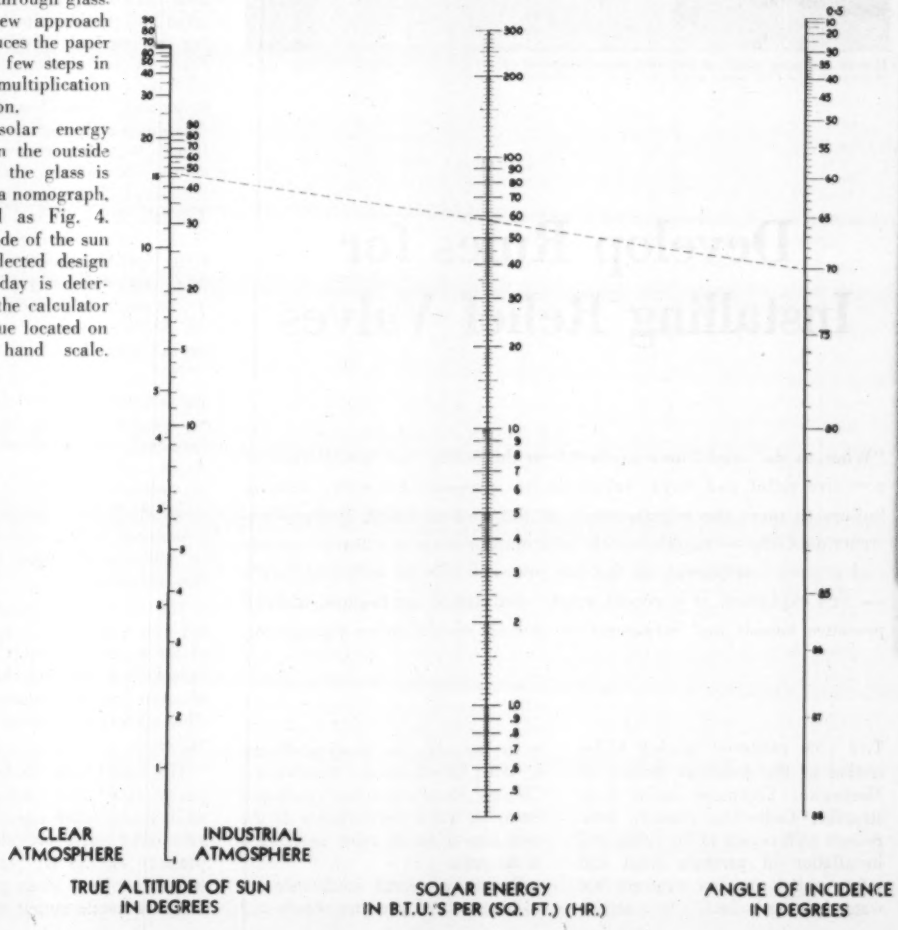
Direct solar energy incident on the outside surface of the glass is read from a nomograph, reproduced as Fig. 4. True altitude of the sun for the selected design hour and day is determined by the calculator and its value located on the left hand scale. Value of the angle of incidence is also determined by the calculator and is located in similar fashion on the right hand scale. The intersection of a line or straight-edge connecting these two points and the center scale indicates the amount of direct solar energy incident upon the glass in Btu per sq ft per hr.

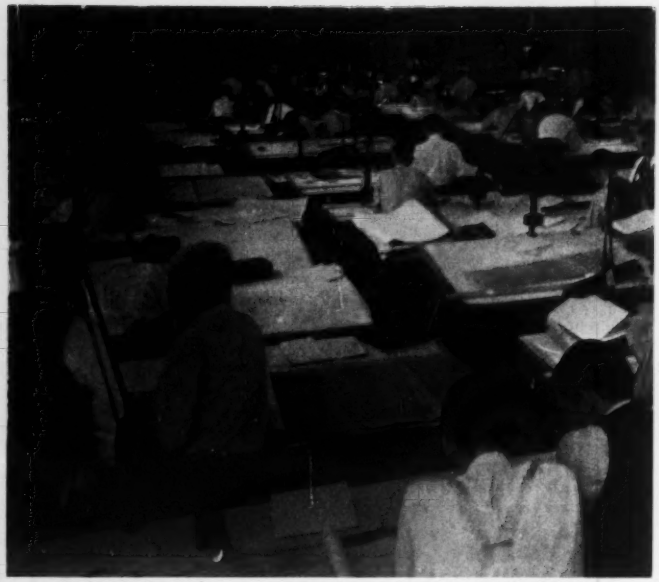
A similar nomograph gives the sky (diffuse) energy incident to the outside surface of the glass in Btu per sq ft per hr.

There remains the problem of determining how much of this incident radiation gets inside the building, whether by transmission or by absorption and reradiation. The booklet contains a table of coefficients which represent the fraction of the incident radiation which reaches the inside through various types of single and double glazings according to the angle of incidence. Proper coefficients are selected from the table and applied to the incident direct and sky radiation values to obtain the total solar heat gain. Once the conditions are established, and with a little practice, the solar heat gain for a given glass area can be estimated in a few minutes.

Sources of data represented by the nomographs and tables are given in a reference section. The booklet also contains a method for converting standard to solar time and other supplementary information.

FIG. 4—DIRECT SOLAR ENERGY on outside surface of the glass is read from this nomograph. Similar chart gives the sky, or diffuse, radiation


CLEAR ATMOSPHERE
INDUSTRIAL ATMOSPHERE
TRUE ALTITUDE OF SUN IN DEGREES
SOLAR ENERGY IN B.T.U.'S PER (SQ. FT.) (HR.)
ANGLE OF INCIDENCE IN DEGREES



How to size safety valves for protecting process equipment on the low side of pressure reducing valves in the event of a PRV failure was discussed at the conference

Develop Rules for Installing Relief Valves

"What to do" and "how to do it" in the sizing and installation of pressure relief and safety valves on low pressure hot water heating boilers to meet the requirements of the revised ASME Boiler Construction Code — together with information on protection of vessels and process equipment on the low pressure side of reducing valves — was explained at a recent safety conference on boilers, unfired pressure vessels and refrigeration and air conditioning equipment.

THE LOW PRESSURE heating boiler section of the American Society of Mechanical Engineers Boiler Construction Code has recently been revised with regard to the sizing and installation of pressure relief and safety valves on low pressure hot water heating boilers. As a service to its members, the Heating, Piping & Air Conditioning Contractors' Chicago Association has condensed the relief valve requirements of the code into a set of rules covering a single page.

During a recent conference on boilers, unfired pressure vessels and their safety appurtenances, sponsored by the boiler and refrigeration department of the city of Chicago in cooperation with the Chicago Boiler Manufacturers Association and the insurance companies which insure boilers and machinery in the Chicago area, E. R. Teske, of the contractors' association, presented a paper discussing these rules.

Use Officially Rated Valves

Pertinent revisions of the code are condensed in the form of six rules. Inasmuch as the first consideration is the type of relief valve to be used, the first rule states simply that only ASME officially rated valves shall be used. Mr. Teske said that there is no point in using nonrated valves, as the code states that the capacity of water relief valves that have not been officially rated shall not be taken into consideration in determining the required relieving capacity. Rated valves have been tested at the laboratory of the National Board of Boiler and Pressure Vessel Inspectors, data sheets and certificates have been issued to manufacturers, and the valves themselves can be distinguished by permanent markings. The data thus given include the name of the manufacturer, the size of the inlet pipe, the pressure setting, the rated capacity in lb per hr of steam or Btu per hr at the set pressure, and the ASME clover leaf symbol bearing the letter "V".

The second rule, regarding pipe size, states that no relief valve shall be smaller than ¾ in. or larger than 4½ in. standard pipe size. Again, officially rated valves are automatically within this requirement, which then becomes of primary importance only in the selection of secondary steam safety valves when they are required.

The third rule indicates that relief valves shall be installed on top of the boiler, preferably through an independent opening, but with as direct and short a connection as possible. There shall be no intervening valves.

The fourth rule, dealing with capacity, says "The minimum required total steam relief capacity of pressure relief valve or valves at their pressure settings is: (a) 1000 Btu or 1 lb per hr of steam per 1000 Btu of gross nozzle output of the boiler

or, (b) 5000 Btu or 5 lb per hr of steam per 1 sq ft of boiler heating surface". Either of these rules is applicable; however, the first was described by Mr. Teske as incorporating the basic intent of the code and as taken from the section on cast iron boilers while the second is from the section applying to steel boilers. When operating conditions are other than normal for steel boilers, the actual gross nozzle output of which the boiler is capable shall be the determining factor.

In conjunction with the total capacity requirements, the Chicago contractors' association has made it a rule for its members that the primary relief valve selected must have a minimum water relief capacity of 1/3 lb per hr of water for each 1000 Btu per hr of required total steam relief capacity. This is not part of the ASME code but is intended to insure adequate capacity of the primary relief valve to relieve simple thermal expansion without opening of the secondary pop valve, which may not reseat without leaking. It may also serve when unusual conditions cause controls to overshoot.

The fifth rule indicates that the primary relief valve shall be set to relieve at a pressure at or below the maximum allowable water working pressure of the boiler or the lowest working pressure component of the system.

Auxiliary Relief Devices Permitted

The sixth rule states that if the size of the boiler is such that more than a reasonable and practical number of officially rated pressure relief valves are required, then the deficiency in relief capacity over that of the total stamped capacity of the primary valves used shall be met by installation of an ASME rated steam safety valve, rupture disc, or similar relief device of sufficient capacity so that the fourth rule is complied with. Steam safety valves shall be of the type without wings or guides on the pressure side of the valve seat. Further, the secondary valve or valves, whether steam safety, rupture disc or similar device, shall have a relief pressure setting in accordance with the following:

a) On 30 psi water pressure boilers, the secondary valve shall be set to relieve at a pressure of 45 psi and shall actually operate at no more than 48 psi.

b) On boilers with water working pressures above 30 psi and up to and including 75 psi, the secondary relief valve shall be set to relieve at a pressure 15 psi above the maximum allowable water working pressure of the boiler.

c) On boilers with water pressures above 75 psi and up to 160 psi, the secondary relief valve shall be set to relieve at a pressure 20 percent above the maximum allowable water working pressure of the boiler.

Discharge Manifolds Not Recommended

After enumerating these rules, Mr. Teske discussed some of the problems confronting contractors and engineers in meeting the code's requirements. One such problem is in connection with multiple valve installations. Manifolds for multiple installations should be as compact as possible and the cross sectional area of the boiler opening should at least equal the aggregate area of the nominal diameters of the connected valves. The association does not recommend manifolds on the discharge piping as there is no assurance that the back pressure due to discharge of one valve would not reduce the discharge capacity of others on the manifold. Even primary or secondary valves with the same set pressure may not open simultaneously, Mr. Teske said. Discharge piping, of course, must be carried to a point where there will be no danger of scalding personnel.

In regard to the question of reverse circulation boilers — that is, returning water through the normal supply openings and using the return tappings as supplies — the code definitely requires the valves to be on top of the boiler and the association considers that it applies to such boilers.

Most of the difficulties encountered in applying the code were said to stem from the problem of determining the capacity requirement when gross nozzle output of the boiler is not known. While the ASME code requires that a code boiler carry the boiler symbol, the name of the manufacturer, the maximum working pressure and the minimum safety relief capacity in lb per hr of steam, it is not required that the valve capacity be given in the manufacturer's literature nor are the data readily visible on boilers in the field. The Steel Boiler Institute requires that its rated boilers carry information as to heating surface, but not gross output, on the boiler data plate. In a similar manner, cast iron boilers rated by the Institute of Boiler and Radiator Manufacturers must show net ratings, but not gross ratings.

Find Gross Nozzle Output

One item of information which is usually available to the contractor or engineer is the net load rating of the boiler. For a large number of steel and cast iron boilers, net load ratings are available in a booklet, Net Load Recommendations for Low Pressure Heating Boilers, issued semi-annually by the Heating, Piping & Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York 20, N. Y.

For automatically fired, hot water heating, cast iron boilers, Mr. Teske said that the gross nozzle output can be determined by multiplying the net IBR automatically fired rating by 1.333. This is said to result in relief valves for the largest size boilers being slightly oversize, but not more than 5 percent.

For steel boilers, Mr. Teske recommended that the gross nozzle output be determined by adding 50 percent to the SBI net load rating. This is said to be equivalent to multiplying the heating surface by 5000 for commercial steel boiler ratings, but to somewhat more than that for SBI net ratings on residential oil fired boilers.

A capacity sizing problem is presented by the packaged steel boiler. Generally speaking, said Mr. Teske, literature for these units indicates the gross nozzle output. Where the gross nozzle output is not known, only 21½ percent need be added to the HPACCNA net load ratings to obtain the gross nozzle output.

Another problem discussed by Mr. Teske is that of overfiring. Under these conditions, the requirements of

Only officially rated valves bearing the symbol "V in a clover leaf" may be used, according to the ASME Boiler Construction Code

TABLE 1—ORIFICE RELIEVING capacities, in lb per hr per sq in., developed for determining the proper size of safety valves to be used on the low pressure side of reducing valves

Outlet pres., psig	Pressure-reducing valve inlet pressure, psig															
	400	350	300	250	200	175	150	125	100	85	75	60	50	40	30	25
250	21000	17100	10800	....	....	....	....	....	....	....	....	....	....	....	....	....
200	21350	18250	15350	10900	....	....	....	....	....	....	....	....	....	....	....	....
175	21350	18250	16000	12600	7250	....	....	....	....	....	....	....	....	....	....	....
150	21350	18250	16200	13400	9540	6750	....	....	....	....	....	....	....	....	....	....
125	21350	18250	16200	13600	10800	8780	6220	....	....	....	....	....	....	....	....	....
110	21350	18250	16200	13600	11000	9460	7420	4550	....	....	....	....	....	....	....	....
100	21350	18250	16200	13600	11000	9760	7970	5630	....	....	....	....	....	....	....	....
85	21350	18250	16200	13600	11000	9760	8480	6640	4070	....	....	....	....	....	....	....
75	21350	18250	16200	13600	11000	9760	8480	7050	4980	3150	....	....	....	....	....	....
60	21350	18250	16200	13600	11000	9760	8480	7200	5750	4540	3520	....	....	....	....	....
50	21350	18250	16200	13600	11000	9760	8480	7200	5920	5000	4230	2680	....	....	....	....
40	21350	18250	16200	13600	11000	9760	8480	7200	5920	5140	4630	3480	2470	....	....	....
30	21350	18250	16200	13600	11000	9760	8480	7200	5920	5140	4630	3860	3140	2210	....	....
25	21350	18250	16200	13600	11000	9760	8480	7200	5920	5140	4630	3860	3340	2580	1485	....
15	21350	18250	16200	13600	11000	9760	8480	7200	5920	5140	4630	3860	3340	2830	2320	1800
10	21350	18250	16200	13600	11000	9760	8480	7200	5920	5140	4630	3860	3340	2830	2320	2060
5	21350	18250	16200	13600	11000	9760	8480	7200	5920	5140	4630	3860	3340	2830	2320	2060

NOTE: The following formulas shall be used in connection with this table to calculate the required relieving capacity of safety valves installed on the low-pressure side of pressure-reducing valves. Use the formula that requires the larger relieving capacity.

$$W = 1/3\ AC \text{ or } W = 1/3\ A_1C$$

where: W = required safety valve relieving capacity.
A = internal area of the pipe size of the pressure-reducing valve (use pipe areas of Table 2).
A_1 = internal area of the pipe size of the by-pass line around the pressure-reducing valve.
C = orifice relieving capacity, pounds of steam per hour per square inch, for the given inlet and outlet pressures of the pressure-reducing valve (from this Table).

the code must be met by determining the nozzle output of the boiler on the basis of burner input and reasonable combustion efficiency. The importance[5] was again stressed of having sufficient thermal expansion capacity in the primary relief valve so that this valve is adequate to care for any overshooting of boiler operating controls. The secondary steam pop valves should not open except for actual runaway conditions, as once they have opened they will probably not reseat without considerable leakage.

In discussing static head, he said that it is usually recognized, and either an open expansion tank or a cushion tank is provided to absorb thermal expansion without undue pressure rise in the system. However, the dynamic or operating heads of circulating pumps, when located on the return side of the boiler, are frequently overlooked. In addition, the surge in head when a pump starts must be considered; according to Mr. Teske, this frequently ranges from 50 to 150 percent of normal operating heads. It should not be neglected even in the so-called constant circulation system. These factors sometimes make it advisable on larger systems with high static heads to install the circulating pumps on the supply side of the boiler so that dynamic and surge heads are dissipated in the systems.

Another difficulty occurs in tall buildings employing hot water heating systems and utilizing heat exchangers between the systems and low pressure steam or hot water boilers. Paragraph U-2 of the unfired pressure vessel section of the ASME code requires a relief valve which permits a maximum rise of 10 percent above maximum working pressure. According to Mr. Teske, the determination of the relief capacity to meet the 10 percent overpressure requirement can be an elusive problem.

Paragraph H-54 of the low pressure heating boiler section of the code states that "When a hot water supply is heated indirectly by steam in a coil or pipe, the pressure of the steam used shall not exceed the safe working pressure of the hot water tank, and a relief valve of at least 1 in. in diameter, set to relieve at or below the maximum allowable working pressure of the tank, shall be applied on the tank".

Believing that neither of these code paragraphs is satisfactory, and pending the incorporation of specific requirements for heat exchangers in the ASME code, the Chicago contractors' association has established a set of rules to serve as a guide for its members. These rules state that as long as the medium supplying heat to the exchanger is within the temperature and pressure limits prescribed in the ASME code, all that is required on the radiation side of the exchanger is an officially rated thermal relief valve.

The total relief capacity provided by this valve at its pressure setting is to be a minimum of 1/3 lb per hr of water for each 1000 Btu per hr of heating load. The requirements with regard to type, pipe size, location and pressure setting are the same as those for boilers. Should the medium supplying heat be over 250 F, or 15 psi for steam and 160 psi for water, the rules for relief valves on heating boilers are to be followed.

Protecting Vessels on Low Side of P.R. Valves

C. O. Myers, secretary-treasurer of the National Board of Boiler and Pressure Vessel Inspectors, discussed protection of vessels on the low pressure side of reducing valves. The subject is one of considerable importance to protect properly auxiliary equipment operating at pressures below that which is carried upon the primary boiler generating unit, he said.

To reduce automatically the primary boiler pressure for such processing equipment, pressure reducing valves are used. The manufacturers of such equipment have data available on the volume of flow through reducing valves manufactured by them but such data are not compiled in a form that enables the results to be deduced readily. To protect the equipment operating on the low pressure side of a reducing valve, safety valves of a relieving capacity sufficient to relieve all the steam and prevent a pressure rise in case of failure of the reducing valve should be installed, according to Mr. Myers.

The pressure reducing valve is a throttling device, the design of which is based on certain diaphragm pressures opposed by spring pressure which, in turn, controls the opening through the valve. If the spring, the diaphragm or any part of the reduc-

ing valve fails, steam will flow directly through the valve and the low pressure equipment will be subjected to the boiler pressure. To protect the auxiliaries operating on the low pressure side of the reducing valve against any possibility of higher pressures than those for which they were designed, safety valves of the proper relieving capacity to maintain the lower pressure should be mounted on the low pressure side of the reducing valve.

In most cases, reducing valves used for the reduction of steam pressures have the same inlet and outlet diameters as the pipe size. In case of failure of a reducing valve, the safety valve on the low pressure side must have a capacity to take care of the volume of steam determined by the high pressure side and the area of the pipe. This means that the safety valves on the low pressure side must be of such capacity that the inlet diameter of the safety valve will be greater than the diameter of the pipe to which it is connected.

When it is necessary — and in most cases it is — that more than one safety valve of a diameter equal to the pipe size to which it is connected is required, it is advisable, if the safety valves are connected to the pipe attached to the reducing valve, that each safety valve have a separate connection to the pipe. It is not advisable to use one opening and attach two or more safety valves to it. It is not important that all the safety valves be mounted on the pipe line connecting the reducing valve to the auxiliaries. Safety valves will be equally effective if attached to some of the auxiliaries, he said.

There are no general rules or data for determining the proper size safety valves, in Mr. Myers' knowledge. It is the general practice to select the size of the safety valves with the same inlet diameter as that of the pipe connecting the reducing valve to the low pressure equipment. This is more or less a rule of thumb which cannot be depended upon due to the variables involved in the relieving capacities of safety valves and the capacity of flow through the reducing valve. He therefore outlined some simple rules for field inspectors to follow when calculating the relieving capacity of safety valves in-

TABLE 2—PIPE DATA, giving internal areas to be used in the formula shown in the footnote for Table 1

Nominal pipe size, inches	Standard		
	Actual external diameter, inches	Approx. internal diameter, inches	Approx. internal area, square inches
3/8	0.675	0.49	0.19
1/2	0.840	0.62	0.30
3/4	1.050	0.82	0.53
1	1.315	1.05	0.86
1 1/4	1.660	1.38	1.50
1 1/2	1.900	1.61	2.04
2	2.375	2.07	3.36
2 1/2	2.875	2.47	4.78
3	3.5	3.07	7.39
3 1/2	4.0	3.55	9.89
4	4.5	4.03	12.73
5	5.563	5.05	19.99
6	6.625	6.07	28.89
8	8.625	8.07	51.15
10	10.750	10.19	81.55
12	12.750	12.09	114.80

NOTE: In applying these rules the area of the pipe is always based upon standard weight pipe and the inlet size of the pressure-reducing valve.

stalled on the low pressure side of pressure reducing valves for the proper protection of the auxiliaries operating at the lower pressures.

Reducing valves have a bypass arrangement so that in case of failure the boiler pressure may be short-circuited into the low pressure line without passing through the reducing valve. When determining the required relieving capacity of safety valves for the low pressure side of the reducing valve, the area of the bypass must be taken into consideration. Therefore, he said, there are two possibilities of introducing boiler pressure into low pressure equipment: first, the failure of the reducing valve, so that the valve will remain wide open; and second, the possibility of the bypass being open.

In the design of the body of the reducing valve, certain restrictions are introduced which reduce the flow area through the valve far below the full flow area of the pipe connecting to it. Various designs have been checked and the restriction of the flow area in the body of the valve varies with different designs, but in no case has a design been found that flowed more than 37½ percent of the volume of steam that would flow through the unrestricted pipe connecting to it, he said, and in the lowest case the figure was 29 percent. Therefore, it has been assumed that the flow area through a reducing valve should be considered as one-third of the area of the pipe to which it is connected.

There are no fixed rules for the size of pipe used for bypassing the reducing valve. For governing the amount of flow through the bypass, there is always a hand operated valve in the bypass, and assuming that it is of the globe type, it is believed that a safe factor to be used for determining the flow of steam through the bypass would be to consider a flow restriction in the valve to equal approximately 50 percent of the area of the pipe connecting to it.

When determining the size of safety valves necessary to protect low pressure equipment when either the reducing valve fails or the bypass is open, one-third of the area of the pipe connecting to the reducing valve, or one-half the area of the bypass line, whichever is the greater, should be used, according to Mr. Myers.

The factors necessary to determine the volume of steam flow on the low pressure side of a reducing valve are the differential in pressure between the pressure on the high side and the low side and the area of the pipe connecting to the high side of the valve. It is practically impossible for the manufacturer to stamp the flow capacity upon a reducing valve, as this will vary with differential of pressure between inlet and outlet.

Table 1 herewith gives relieving capacity in lb per hr per sq in. at variable reductions of pressure varying from 400 psi inlet to 5 psi outlet. With the steam capacity flow being known between various pressure reductions, all that is necessary for the inspector to do is to calculate the area of the inlet pipe size. The footnote for Table 1 includes a formula that shows its application. With this information, it is believed that the proper size relief valves to be used on the low pressure side of reducing valves can readily be calculated, Mr. Myers concluded.

[At the same conference, the regulation of water used for air conditioning and refrigeration was also discussed, as reported in the March HPAC.]

DATA sheet

MIMA Specification for the Insulation of Heating Systems in Commercial and Institutional Buildings, and Multiple Dwellings, just adopted by The Magnesia Insulation Manufacturers Association.

1 GENERAL

1-1 This specification outlines the requirements for the application of 85% Magnesia and related materials for insulation of piping and equipment, including the following:*

1. Heating supply and return piping
2. Domestic hot water supply and return piping
3. Hot water heaters and storage tanks
4. Boilers (sectional type)
5. Boiler steam drums and heads (water tube type)
6. Boiler shell (return tubular type)
7. Feedwater heaters
8. Boiler flues and breechings
9. Boiler stacks within buildings
10. Kitchen range hoods and exhaust ducts
11. Warm air heater casing, fan units, ducts and flues
12. Pumps and auxiliary steam turbines
13. Steam supply and exhaust piping
14. Receivers, return tanks, traps, etc.
15. .....
16. .....
17. .....

The extent of the work to be done is shown on the drawings listed in the Schedule of Drawings and is indicated in the list on Page ..... of this specification.

1-2 Sections ..... of the specification are not applicable to this installation.

2 MATERIALS

2-1 Insulation

2-1-1 *Molded Insulation* — Sectional, segmental and block insulation as hereinafter specified shall be "85% Magnesia," containing not less than 85% hydrated basic magnesium carbonate and a minimum of 10% asbestos fiber.

2-1-2 *Insulating Cement* — 85% Magnesia in cement form.

2-2 Related Materials

2-2-1 *Asbestos Cement* — An asbestos fibered insulating cement with binding qualities which produce a smooth finished surface.

2-2-2 *Hard Finish Cement* — A mixture of Portland cement and asbestos cement in the ratio of 1 part Portland cement to at least 2 parts asbestos cement, by weight.

2-2-3 *Canvas Jacket* — Factory applied canvas.

2-2-4 *Roofing Jacket* — Asphalt roofing of not less than 45 lb per 108 sq ft.

2-2-5 *Plastic Weather-proofing* — An emulsified asphalt and asbestos coating furnished in ready-mixed plastic form.

2-2-6 *Bands* — For pipe insulation, as supplied by the insulation manufacturer; for block insulation, galvanized steel bands, not less than ½ in. x 0.015 in.

2-2-7 *Wire* — For insulation, annealed iron wire of #16 gage; for roofing felt jackets, copper coated or galvanized steel wire.

2-2-8 *Wire Mesh* — Galvanized, hexagonal wire, 1 or 2 in. mesh.

2-2-9 *Cable* — ⅛ in. galvanized, stranded cable.

2-2-10 *Paste* — Cold water paste prepared from organic materials or silicate of soda.

2-2-11 *Lap Cement* — Standard grade asphalt compound as usually furnished with prepared roll roofings.

3 THICKNESS

Unless otherwise noted, thicknesses of insulation to be used are listed in Tables 1 and 2 following. These do not include thickness of asbestos cement or other finishes.

TABLE 1 — PIPE INSULATION THICKNESS*
(Nominal Inches)

Temperature Range, F	Pipe Sizes (Inches) ½ to 3½	4 to 6	7 to 10	12 and over
100-200	1	1	1-½	1-½
201-300	1	1-½	1-½	2
301-400	1-½	2	2-½	2-½
401-500	1-½	2	2-½	3
501-600	2	2-½	3	3-½

TABLE 2 — EQUIPMENT INSULATION THICKNESS*
(Nominal Inches)

Temperature Range, F	Insulation
100-200	1-½
201-300	2
301-400	2-½
401-500	3
501-600	3-½

*Specification writer should add to or delete from the above list according to the requirements of the job.

*Thicknesses for average conditions; exceptional conditions may necessitate thicker insulation. For outdoor lines and equipment, use ½ in. thicker insulation than that listed.

4 APPLICATION

4-1 Insulation

4-1-1 *General*

Before insulation is applied, all surfaces shall be thoroughly cleaned of all foreign materials, grease and rust.

Sections, segments, and blocks, as the case may be, shall be carefully fitted to the surface, butted tightly together, and joints staggered where possible. Where double layer insulation is used, side and end joints of the outer layer shall be staggered with respect to those of the inner layer.

4-1-2 *Piping*

4-1-2-1 Single Layer — When the insulation has been fitted to the pipe, the side and end laps of the factory-applied canvas shall be pasted down. Where piping is exposed, metal bands shall be applied on 18 in. centers.

4-1-2-2 Double Layer — Staggered joint construction — The inner layer shall be wired in place with not less than three loops of wire per 3 ft section of insulation. The loops shall be twisted together, bent over, and carefully pressed into the insulation. The outer layer shall be applied as described under Single Layer (4-1-2-1).

4-1-3 *Fittings and Valves*

4-1-3-1 For Piping 3-½ in. in Diameter or Less — Fittings and valves shall be insulated with insulating cement in two or more layers, bringing the total thickness to that of the insulation on the adjacent piping.

4-1-3-2 For Piping 4 in. in Diameter or Larger — The bodies of flanged fittings and valves, the entire surface of screwed fittings, and the entire surface up to the bonnet of screwed valves shall be insulated with block or pipe insulation, and/or insulating cement applied up to a total thickness equal to that of the adjacent piping. The insulation shall be carefully cut to fit and firmly wired in place. Two coats of asbestos cement shall then be applied over the insulation so as to make the total thickness of insulation and finish equal to that of the adjacent pipe insulation. The first coat shall be left with a rough surface and allowed to dry thoroughly, and then the second coat shall be applied and troweled to a smooth surface.

4-1-4 *Flanges*

4-1-4-1 Pipe insulation adjacent to flanges shall be beveled off, to permit removal of flange bolts when necessary.

4-1-4-2 Flanges shall be insulated in the manner described in 4-1-3-2 for fittings and valves.

4-1-4-3 Flange insulation shall extend not less than 2 in. over the adjacent pipe insulation on each side of the flange. The annular space between pipe and flange insulation shall be filled with insulating cement or molded insulation cut to fit.

4-1-4-4 The flange insulation shall be wired on separately, so that it may be removed, if necessary, without damage to the adjacent pipe insulation.

4-1-5 *Equipment*

4-1-5-1 General — Equipment shall be insulated with curved or flat blocks held in place with wires or bands. A sufficient number of wires or bands shall be used so that a tight, secure fit is obtained. Where necessary, straps, clips, angles, bolts, etc., shall be used to support the insulation against slippage and to serve as anchor points for the wires and bands. These items shall be supplied and installed by others at locations designated by the insulation contractor.

Small irregularly shaped equipment shall be insulated with block and cement in the same manner as valves and fittings as described in 4-1-3-2.

Insulation on cover plates or heads of equipment shall be cut back so that the bolts may be removed without disturbing the insulation.

Insulation around equipment openings shall be beveled off, and strap iron edgings shall be provided around openings to protect adjacent insulation from damage when covers are removed.

4-1-5-2 Steam Drums and Drum Heads — Insulation on the drum shell shall be held in place by bands on 1 ft centers. The bands shall be drawn tightly from clips or other anchorages welded to the shell surface. Wire shall then be cross-laced through the bands and tied to the same anchorages. Drum head insulation shall be held in place by wires tied at one end to a wire cable looped around the manhole opening and at the other end to hairpin wires looped through cables around the drum shell.

4-1-5-3 Tanks and Heaters — Insulation on the cylindrical body of tanks or heaters shall be held in place with metal bands, on 1 ft centers. On the ends of horizontal tanks or vessels the insulation shall be held in place with wires laced over the blocks and fastened to a wire cable looped around the circumference behind rivet heads, piping, or other projections. The tops of vertical tanks or vessels shall be insulated in the same manner as the cylindrical portions.

4-1-5-4 Pumps and Auxiliary Turbines — Steel anchors shall be welded to the casing of the pump or turbine on approximately 18 in. centers. All irregularities in the equipment surface shall be filled and leveled over with insulating cement. Blocks shall be applied over the dry cement surface, and secured with wire, tied to the anchors.

4-1-5-5 Ducts, Breechings and Flues — If the surface of the duct, breeching or flue has no stiffeners or other projections, the insulation shall be applied directly to the surface and fastened in place with bands on 1 ft centers. Beading shall be used on the corners to prevent bands from cutting into the insulation and to guard against later mechanical damage.

If there are widely spaced stiffeners or other projections, the insulation shall be applied directly to the surface between the stiffeners. If the stiffeners do not project beyond the insulation, the blocks shall be fitted closely against the stiffeners and joints filled with insulating cement.

If the stiffeners protrude beyond the insulation, pipe or block insulation shall be built up flush to the projections and wired in place.

If the stiffeners or other projections are closely spaced, metal strips, heavy iron wire fabric, or V-rib metal lath shall be fitted and fastened over the surface with wires, to form a foundation for the insulation. The insulation shall then be applied, and securely wired to the metal strips, wire fabric, or V-rib metal lath.

4-2 *Finish*

4-2-1 *Indoor*

4-2-1-1 Piping — Unless otherwise noted, pipe insulation shall be finished with the pasted, factory-applied canvas as described in 4-1-2-1. If uninsulated metal is adjacent to the insulation, the canvas shall be stopped a few inches short of the end of the insulation, and the exposed length of insulation shall be finished with asbestos cement.

4-2-1-2 Flanges, Fittings and Valves — Insulation shall be finished with a pasted canvas jacket.

4-2-1-3 Equipment — Over the equipment insulation, a layer of hexagonal wire mesh shall be tightly stretched and wired in place. Two layers of asbestos cement shall be applied to a total thickness of ½ in. The first layer shall be left rough and allowed to dry thoroughly before the second layer is applied. The second layer shall be troweled to a smooth surface.

4-2-1-4 Painting — Painting of insulation surfaces, where required, shall be done by others.

4-2-2 *Outdoor*

4-2-2-1 Piping — After the pipe insulation has been applied, a roofing felt jacket shall be applied. Laps of not less than 3 in. shall be provided at all edges, and they shall be sealed with lap cement. All horizontal joints in the felt jacket shall be lapped downward so as to shed water. Wire shall be fastened around the felt jacket at not more than 6 in. centers.

4-2-2-2 Flanges, Fittings and Valves — Plastic weatherproofing shall be troweled on over the flange, fitting or valve, to a thickness of ¼ in. when wet. The plastic shall be used in the form supplied by the manufacturer, without additives, unless the manufacturer recommends otherwise.

4-2-2-3 Equipment — Hexagonal wire mesh shall be stretched over the insulation and wired firmly in place. A ¼ in. thick layer of hard finish cement shall then be applied. After it has dried, a layer of hexagonal wire mesh shall be stretched over the cement and wired firmly in place. Plastic weatherproofing shall then be applied.

QUESTION of the Month

QUESTIONS ON heating, piping and air conditioning asked by HPAC's readers are answered here each month. We hope you find these practical comments of regular interest, and will contribute either a question, or an answer to a published question, on occasion. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Illinois.

HEATING ENTRANCE TO DEPARTMENT STORE

IN RESPONSE TO THE Question of the Month in the January issue concerning heating of the entrance for a large department store, if the light court is open to each floor, it is bound to present considerable trouble in the winter time particularly, because of its stack action. In any case, I would certainly recommend that it be partitioned off from the lobby or entrance. (As far as light courts of this type are concerned, my opinion is that the space occupied by them could be utilized for better purposes; their entire elimination would provide additional and valuable floor space). Elevators alone will cause enough difficulty in heating lobbies and entrances even though they are entirely enclosed and equipped with solid doors.

I have seen many different schemes tried for heating entrance vestibules, but very few could be considered satisfactory under heavy traffic for a store with sales space near the entrance doors. Too many times it appears that this very real problem has been "solved" with halfway measures.

In answer to "R. G.," who asked the January question, I would recommend the use of perforated ceiling panels over the *entire* ceiling area and the introduction of 3600 cfm of 75 deg air through these panels with a run-around or recirculating system. The air would be exhausted through a continuous floor grille located between the inner and outer doors but as close as possible to the *inner* doors. This would be a continuous grille from one side of the entranceway to the other, 6 in. wide for fairly high entrance velocity, and would connect into a watertight duct below so that any water from melting snow and any sweepings could be readily collected. Because of the nature of materials which would be drawn into this grille, I feel it should be drawn through a centrifuge of some kind, if space permitted, and then through ordinary filters before entering the fan.

I would recommend discharging the air through a heating coil provided with face and bypass dampers, controlling the dampers with a thermostat which gives accurate and rapid response. This thermostat would be located on the leaving side of the coil (as far as possible from the coil) to maintain an entrance air temperature of approximately 75 deg as mentioned before. A control which would allow too wide a variation in temperature or would be too sluggish in operation to take care of quick changes such as experienced in an entrance of this type should not be used.—R. V. G.

HEATING A STORE ENTRANCE

THE PROBLEM OF heating a store entrance, submitted by "R.G." in the January HPAC, is one that has been the nemesis of many otherwise satisfactory air conditioning installations. However, ventilation is certainly no problem; in fact, if the store is reasonably busy, the entrance will be the most ventilated spot in the store, without any mechanical assistance.

Unlike a revolving door, the "double-drum" entrance shown by "R.G." could conceivably admit a continuous blast of outside air, particularly when the foot traffic, in and out, is excessive. I believe this to be the big problem. There is little that can be done economically during the cooling season, but during the heating season, a heat exchanger in the form of a unit heater could be installed to recirculate the air of the inner entrance, thereby tempering the infiltration air.

For control, a remote bulb temperature controller with the bulb protruding from the ceiling, located about 10 ft inside the store in line with the entrance, set for 2 deg less than the desired store temperature, and wired to the entrance heating equipment for on-off control could be used to eliminate the possibility of excessive overheating during the slack periods of low infiltration.

Actually, there is no practical method of preventing the entrance of outside air. Even a revolving door, which is probably the closest approach to the problem, will admit outside air by displacement not unlike the operation of a pump. The available data on this subject are practically nil in the shape of formal texts, but some data can be found in the engineering sections of the complete catalog manuals furnished by some air conditioning equipment manufacturers.—A.A.H.

USE REVOLVING DOORS TO SIMPLIFY STORE HEATING

IN REPLY TO THE question on heating a store entrance, posed by "R.G." in the January issue, I think the following may help.

To attempt to prevent the entrance of all outside air into the store by introducing air in the space between the doors is a practical impossibility. The air in this area would have to be at a high enough pressure to prevent gusts of wind from entering the exterior row of doors. If this were done, it would be more difficult for customers to open the interior doors and enter the store, something which no sales-minded store manager would find acceptable.

From the sketch accompanying the question, it would seem that the stack effect of the light court and the mechanical exhaust ventilation are contributing to put the lower store entrance on the low side of pressure differential in respect to the existing barometric and wind pressures.

With the foregoing in mind, I suggest that three 72 in. revolving doors be substituted for the interior row of four swinging doors. This will accomplish two things. First,

revolving doors are appreciably better in preventing infiltration due to wind than swinging doors. Second, any difference in pressure on the opposite sides of the door is balanced by the fact that the resultant moments on the door act around a central pivot point. The only force the customer must overcome is that due to friction.

By introducing air into the vestibule between the doors, the effect of infiltration can be reduced both in summer and winter. That is, the temperature differential between the vestibule and the store is decreased, thus eliminating some discomfort to the customers and employees within the store in the vicinity of the doors.

Calculation of the quantity of air can be made by reference to the book, Modern Air Conditioning, Heating and Ventilating, second edition, by Carrier, Cherne and Grant. The temperature at which the air should be introduced into the vestibule can then be determined to give a resultant mixture at some intermediate temperature between that outdoors and in the store.—M.D.

CORRECTING FAULTY HOSPITAL HEATING

IN THE FEBRUARY HPAC, "C.H.B.," the maintenance manager of a hospital, asked for suggestions for correcting unsatisfactory operation of a steam heating system installed in his building. It is assumed that this system is equipped with a vacuum pump and that the oil burner is operated from a room thermostat.

The combination of cast iron radiators and convector radiators in a steam heating system is not a desirable one and should be avoided whenever possible. Due to the different rates at which these two types of radiators heat and cool, a combination of them when used in a system having "on-off" type control produces a common complaint — that the convectors cool much more rapidly than the cast iron radiators.

Such a combination of radiation can be used successfully only if the steam supply to the radiation is constant but varied to maintain desired building temperature throughout the wide range of varying outside temperature. This is accomplished accurately and economically by use of equipment which supplies steam constantly to the radiation at atmospheric pressure or higher during severe weather and at subatmospheric pressure in milder weather, up to the point of complete shutoff when heat is no longer required.

The equipment suggested consists of an electrically operated steam control valve which varies the heat supply to the building in response to changes in heat demand as measured by temperature sensitive control devices located in the building. Also, the radiators and drip points in this system must be equipped with traps. The vacuum pump must have sufficient air capacity to produce a maximum vacuum in keeping with the air leakage into the system.

Temperatures throughout the building can be balanced by use of an orifice plate in each of the present radiator valves, or replacement with valves having an internal orifice which is externally adjustable.—J. W. J.

HOW WE PLAN TO SOLVE SAME PROBLEM

REFERRING TO THE question from "C.H.B." in the February HPAC regarding difficulties with his hospital heating system due to the combination of cast iron direct and convector radiation used, evidently this is a common problem and we have encountered it at our plant.

Our present plan is to convert our boilers to oil burners but they will not operate from thermostat controls. Control will be maintained through steam pressure regulators and a minimum pressure will be maintained at all times. The convection heaters will then be further controlled by thermostats to regulate the heat in the department with a separate aquastat or pressure control to shut off the fans in case of a boiler shutdown where pressure is not maintained.

While this system will be automatic in its general operation, there will be a manual control in the boiler house because the complete system involves three different boilers. If one boiler does not have capacity enough to maintain the minimum steam pressures required by the pressure controls it will then be necessary to manually connect two or more boilers into the same circuit.

I have visited two or three other installations where this system is in operation and feel confident that this will take care of our problem.—F. W. C.

ANSWERS TO HEATING PROBLEM MOST HELPFUL

THE VERY PROMPT and very good answers to my problem in heating the hospital of which I am maintenance manager — which problem was published in the February HPAC — are greatly appreciated.

All seem to agree that the convector radiators should not be connected in conjunction with the cast iron radiators. "S.R.L.," in the March issue, suggests circulating hot water, and this sounds good.

I might point out here that we have added a cast iron radiator to the surgical suite, and this has helped out some.

"G.C.D." also suggested a wonderful plan for steam control valves on the main supply lines, but this being a small hospital we have to economize in every way possible. It seems that his plan might involve quite an expenditure of funds. All in all, we have decided to follow the second suggestion of "S.R.L.", and put some of the best cast iron radiators in surgery and move some of the convectors to warmer locations.

I say "thanks a million" to everyone contributing to my problem, and of course sincere thanks to HPAC. —C. H. B.

WANTS TO KNOW ABOUT GERMAN HEATING DESIGN

You are invited to answer the following questions from a reader of HPAC. Please address your reply to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"During the past three years, I have worked with several foreign designers (German, Danish and Japanese) of heating systems, and without exception they calculate heat losses, pipe sizes, etc., by the Rietschel-Brabbee 'Heizungs-und Luftungstechnik' method.

"I wonder if this method has advantages over that shown in the Guide, published by the American Society of Heating and Ventilating Engineers? Also, where can a translated copy of their method of calculation be obtained?

"Any comment on this method of calculating heating systems, and its advantages or disadvantages, would be helpful and appreciated." —M. A. Y.

Sam Lewis Page

. . . . . practical comment on pertinent problems

INFORMAL COMMENT on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors.

LOTS OF TROUBLE WHEN HEATING DESIGN IS WRONG

[The following story is published only to show the difficulties created when a heating system is poorly engineered and installed, and in no way reflects on warm air for a building of this type — as an incorrect steam, hot water or any other type of installation would be just as bad. A properly selected furnace for the job to be done, revised ductwork, and a larger fan and filters are now being put in so that the system will meet the building's requirements with entire satisfaction.]

I WAS CALLED UPON not so long ago to inspect a warm air heating plant in a three story apartment building which faces north and has three four-room apartments on each story. Originally, it must have been heated by stoves, as I found no evidence of other equipment.

A contractor convinced the owner that a fan-equipped warm air furnace would do the job, burning fuel oil, with air supply ducts to the principal rooms and with two return air ducts from the two separate and mutually remote stairways. The contractor collected part of the agreed price before the beginning of the heating season and sold the unpaid balance of the owner's alleged obligation to a neighborhood bank. When cold weather arrived, the occupants of the building were unhappy. Comfort could be approached only by aid of the kitchen stoves, some portable electric heaters and some borrowed gas stoves.

The owner then was greatly disturbed, but was compelled to pay the bank. The contractor, evidently under pressure from the bank, removed the air filters, altered one or two of the air supply ducts — and apparently resigned. The owner hoped to recover some part of his investment and I was retained by his attorney.

There never had been any drawings of the building. I could find no evidence of an intelligent computation of the heat losses. No plans of the building or of the air ducts were found.

The plant included a reputable make of oil burning warm air furnace and built-in fan, with an oil burner of reasonably acceptable pedigree. The automatic control comprised a thermostat in the furnace bonnet that would start the fan motor if the bonnet temperature reached the preset degree, and that would stop the fan motor if the bonnet temperature was too cool. The oil burner motor responded to a wall-mounted thermostat in the owner's first story store.

There was a trunk line air duct running north from the furnace, with an 8 in. diameter branch duct every little way, these feeding a first story floor register or a basement grille. A similar little round branch duct ran to a 12 by 6 in. vertical duct to serve each of two super-imposed rooms, one on the second story and one on the third story. The metal risers to the second and third stories were directly against the cool outside walls without any insulation and usually were without any enclosure.

At the second story, near the floor, there was a register in this duct and the same duct then was reduced to 12 by 3 in., and continued on up to the third story room. No openings to encourage air flow from the rooms to the stair halls for recirculation could be found. The trunk line recirculation duct in the basement had approximately half the cross sectional area of the corresponding supply duct.

The south half of the building had similar arrangements to the north half and was equally unpleasant. The quality of workmanship was entirely unacceptable, as walls and floors and ceilings had been ripped through with little attempt to patch or repair. Alterations in some of the 6 in. branch ducts when attempting improvement were roughly done and many of the leaky joints in the ducts were patched with ordinary scotch tape.

There were cold tenants, sick babies and no friends to this heating system. The thermostat that controlled the oil burner was moved from the first story to the third story without any appreciable improvement in the overall condition. There is no one room in a building of this character in which the oil burner thermostat has a chance to be acceptable.

The catalog of the furnace manufacturer did not disclose the particular furnace that was installed. After considerable correspondence, the manufacturer identified it as an obsolete model. I reported, however, it should be able to do the job well enough had it been big enough and had it been well installed. The manufacturer stated that acceptable and economical practice in selecting his furnace by its bonnet rating is to compute the heat demand at the rooms, and to add at least 25 percent to this. Thus, if a room has a heat demand of 10,000 Btu, the furnace chosen should be able to deliver 12,500 Btu at the bonnet, so as to allow for heat losses and leakage from the ducts, flues, furnace casing, etc. This practice is well substantiated by experience.

In this apartment building I measured the rooms, made a plan and computed the heat losses accurately. I found a demand, at the rooms, of 288,000 Btu. If we add 25 percent for transmission losses, then the furnace should be able to deliver 360,000 Btu at the bonnet. The verified and certified rating of this furnace at the bonnet, however, is 250,000 Btu.

Heating, Piping & Air Conditioning

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL SECTION

Man and His Relationship to Air

Lester T. Avery, Presiding **Nathaniel Glickman, Moderator**

THE subject, Man and His Relationship to Air, was introduced by Lester T. Avery, President of THE AMERICAN SOCIETY OF HEATING and VENTILATING ENGINEERS, as follows:

Our Society has for many years taken an active part in physiological research, starting in the 1920's, when through our own research we developed the effective temperature chart and the effective temperature lines, and later, as we conducted a great deal of research on man in hot industries and other environments. We have several committees interested in physiological research. At present we have the Committee on Physiological Research, with Prof. M. K. Fahnestock as Chairman; the Committee on Sensations of Comfort, with C. S. Leopold as Chairman; and the Committee on Human Calorimetry, with Prof. G. L. Tuve as Chairman. In many other ways we are engaging your money and your interest in physiological reactions.

It was my privilege this year to attend a symposium at the *University of New Hampshire* in connection with the dedication of the Engineering Building under Dean L. E. Seeley. The title of the symposium was, *Science and Engineering in the Service of Mankind*. A two-day session was devoted to the relationship of science and engineering to man. I also attended a meeting of the *American Association for the Advancement of Science* in Cleveland where the subject, *The Human Body as a Factor in Engineering*, was discussed by able speakers.

For our meeting this morning we have a group of able speakers. The Chairman of the meeting is our own Prof. N. Glickman who will handle the presentation of the speakers. The plan is to have the five speakers present their material first and then the meeting will be open for discussion from the floor. Please make notes of questions or comments that occur to you as we proceed, because all speakers will deal with equally important phases which are part of the general subject.

I want to mention the entire program so that you will see what we are trying to accomplish as we attempt to cover the field. Prof. N. Glickman, Chicago, Ill., will be the Moderator at the Symposium, and our speakers will be Eugene F. DuBois, M.D., New York, N. Y.; Charles S. Leopold, Philadelphia, Pa.; Prof. Theodore F. Hatch, Pittsburgh, Pa.; Robert W. Keeton, M.D., Chicago, Ill.; and Capt. Oscar Schneider, U. S. N., Washington, D. C.

MODERATOR GLICKMAN: During the past quarter of a century, engineers in the field of heating, cooling, and ventilating have made tremendous progress through research. This progress has been made not only in the development and application of new and improved equipment for obtaining desired environmental conditions, but also in a better understanding of the complex relationship of man to his physical environment. Just as the physician strives to improve the health of his fellow man, so the engineer strives to improve the living conditions of his fellow man. The Research Laboratory of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS has pioneered in this field. It has developed the effective temperature index with which most of you are familiar. It brought out comfort curves showing the conditions in which various percentages of people would feel comfortable; and it did fundamental research in heat loss and heat production of the body under different environmental conditions and at different levels of activity.

Other research laboratories have cooperated in similar studies so that we have come a long way toward answering many of the problems. For example, we know many of the changes that take place in the body as the result of exposure to the stress of a hot or a cold environment.

I say we know many of the changes; we don't know all of them. Perhaps in the near future we may learn some other changes which may be even more important than many of the changes that we now recognize.

We do not have answers to certain other problems. For example, a very simple problem which is still elusive is: What is a good method of measuring objectively the factor of comfort? We still have to go back and say, "How do you feel?" However, we have achieved much in our knowledge of the response of the body to the stress of different environmental conditions and we have applied some of that knowledge.

This morning, as we tap some of the wells from which much of this knowledge has sprung, we present five authoritative speakers and it is a pleasure to me — a real pleasure — to participate in this program. It is a pleasure for several reasons. First of all, this is a field in which I am much interested. Second, it is not only a pleasure, but also an honor to introduce each of the speakers. And finally, I don't have to get up here and deliver a paper this morning!

You may know that Mark Twain once defined climate as "weather and more of it." This morning we are going to hear a lot and learn a lot about climate and how it affects us in our everyday lives. We have already asked our participants to discuss their material in descriptive terms so that if they don't cover a particular phase of the subject of which you would like to hear more detail, just jot down a note and you will have an opportunity during our question-and-answer period to ask any question or questions of any of the speakers. Captain Schneider, of course, will have the privilege of refraining from answering any question which in his opinion may be classified as hush or hush-hush.

A Symposium held at the 57th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in Philadelphia, Pa., January 24, 1951.

Physiological Aspects of Heating and Ventilating

By Eugene F. Du Bois

EUGENE F. DU BOIS, M.D., New York, N. Y.—Emeritus professor of physiology, Cornell University Medical College, and former Medical Director of The Russell Sage Institute of Pathology. Graduated from Harvard in 1903 and from Columbia College of Physicians and Surgeons in 1906. Has been associated with Cornell Medical College since 1910, as professor of Medicine 1930-41, and as professor of physiology 1941-50. His research has been in the fields of human metabolism, heat production and heat loss, gas warfare, submarine ventilation and aviation medicine. In World Wars I and II he served in the Navy Medical Corps.

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS is to be congratulated on the work that it has done in the field of human requirements. It has endeavored to provide engineers with the sort of standards and specifications that engineers need. In doing this, it has very properly invaded the field of physiology, and has found that physiologists are reluctant to confine themselves by standards and specifications. There are too many variables. The human body has to be variable if it expects to cover the earth from the Arctic to the equator.

Therefore, it is important that physiologists and engineers confer more often and learn to speak each other's language. At once we encounter great difficulty in language. The engineers speak and write in terms of Fahrenheit, square feet and Btu. The physiologists live in a realm of Centigrade, square meters and large calories. Today I bring you a message from a group of physiologists representing all the continents. Forty-three research men in the field of heat and cold held a special meeting last August at the close of the *International Physiological Congress* in Copenhagen. They issued a special request that American and British engineers writing in terms of Fahrenheit and Btu add in brackets the equivalents in Centigrade and calories. This will not cause you much trouble, and it will be a great convenience to many of your readers.

Perhaps the physiologists have been somewhat neglected, not only in the matter of language but also in the matter of teaching. As teachers, your main object is to show your pupils how to accommodate or balance man's heat loss by changing his environment.

Both the heat loss and the environment are of equal importance. Should not the laws governing each receive equal emphasis in your text books? As this seemed rather important to me, I went to your headquarters and examined six of your most recent text books, all of them books of high quality. One of them devoted as many as 4.2 percent of the pages to the human heat loss, but the average for all six was only 3 percent. May I suggest that when you revise your texts you consult three excellent new books, Winslow and Herrington's *Temperature and Human Life*[1], Bedford's *Basic Principles of Heating and Ventilating*[2], and Newburgh's *Physiology of Heat Regulation and The Science of Clothing*.[3]

All that I can do in this short paper is to point out some of the more recent trends in the fields that are covered so well by these authors. First, it is necessary to see why it is difficult to define the comfort zones. In order to make the matter as simple as possible, we may confine the discussion to the conditions in the living room of a small house.

Fig. 1 is illustrative of a typical family with the heat production and loss expressed in the usual terms of calories per square meter of surface per hour. Fortunately, both physiologists and engineers express heat loss in terms of surface area. An average man has a surface area of about 1.74 square meters (18.7 sq ft).

[1]Exponent numerals refer to References at the end of this presentation.

It will be noted that the lowest metabolism and heat loss per square foot of skin is found in the elderly grandmother asleep on the sofa, and the value is only a little higher when she is awake and quiet in her chair. This is distinctly lower than the figures for *father basal* and *father quiet in a chair;* and it so happens that most experiments are made on men in the basal condition (motionless in bed 14 hours after the last meal) or else on men sitting quietly in a chair. Much higher values are found for mother, father and baby when they are showing more typical activities. The highest level of 300, ten times grandmother's heat loss, is represented by *Junior* when he is dancing with his 'teen age girl friend.

Probably each member of the family except baby would like to adjust the temperature of that living room to his own immediate requirements. Probably the one who dictates the temperature will be grandmother, and she will want it very warm.

In Fig. 2 are shown the factors concerned in the thermal balance between man and his environment. The human factors determine the level of heat production and therefore the need for heat loss. The heat produced in the muscles and internal organs is transported to the skin by the peripheral blood flow, and is dissipated from the surface by radiation and convection aided by insensible perspiration and perhaps by sweating. The

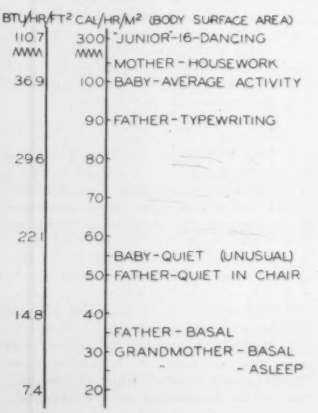


Fig. 1. Heat production in relation to activity in typical family.

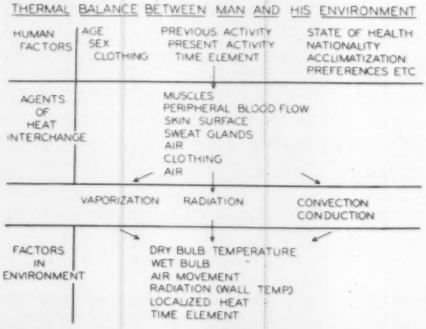


Fig. 2. Factors concerned in heat balance of man and environment.

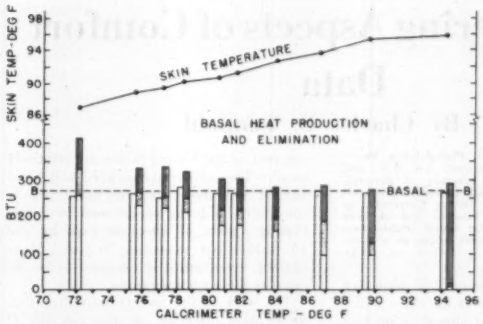


Fig. 3. Heat production and heat loss for man in calorimeter.

Heat production and heat loss of a normal man, naked in calorimeter at temperatures from 22.7 to 34.5 C (72.9 to 94.1F). The first column in each experiment represents heat production as determined by oxygen consumption; the second column, heat elimination determined by physical measurements. The portion marked by vertical lines represents vaporization; the dotted area, convection; the unmarked area, radiation. The skin temperature represents the average reading of 18 spots on the surface.

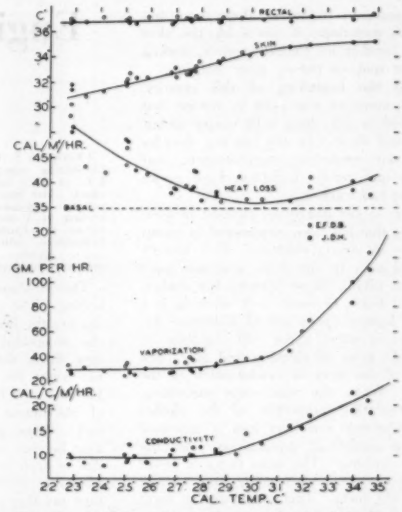


Fig. 4. Relationship of factors involved in heat loss to environmental temperature.

The lines show the averages obtained on two normal men, one of them the same subject shown in Fig. 3. The Basal line gives their average heat production, 35 calories per square meter of body surface per hour. The conductivity line represents the conductance of heat through the skin.[4]

heat travels through still air to the clothing, through the clothing and thence to the air and walls. The recipient of this heat is the environment.

If heat production and heat loss are not in equilibrium, there must be a storage or loss of heat in the clothing, in the peripheral layers of the body, or in the deeper core of the body.

With so many factors and agents to be considered, it is extremely difficult to establish standards and specifications. With regard to heating, the only simple means to be used in this confusion are the old dry bulb thermometer and the complaints of the persons who are too cold or too hot. The experimenter who tries to study the laws of heat production and heat loss must reduce the number of variables if he hopes to study one factor at a time.

In Fig. 3 are given the results obtained by us on one man who was studied in the Sage respiration calorimeter[4] on many different days at environmental temperatures from 22 to 35 C (72 to 95 F). In order to eliminate the effect of clothing, he was naked; in order to eliminate the effect of activity and recent food, he was in the basal condition, almost completely motionless. Air and wall temperatures were identical. Humidity and air movement were low. The experiments, lasting 2 to 3 hr, followed a preliminary adjustment period in the box of 1 to 2 hr. The man was comfortable, except in the cold zone when he was on the verge of shivering, and in the hot zone when he was sweating profusely.

It will be noted that his heat production, shown in the open columns, was very close to his average basal. His heat loss, as given in the second column of each experiment, was much higher than his production in the cold zone, and this heat was evidently lost from the skin and subcutaneous tissue. In his individual comfort zone, 29 to 32 C (82 to 90 F), heat loss and heat production were about equal. The heat lost by radiation was great in the cold, but diminished to zero when, at 34.5 C (94 F), the wall temperature was the same as the skin temperature. The loss by convection also dropped to zero when the air temperature was the same as the skin temperature. Loss by vaporization represented about one quarter of the total loss in the cold zone and comfort zone, but increased greatly at 32 C (90 F), and at 34.5 C (94 F) had to take over the responsibility for the total heat loss.

Fig. 4 gives the averages for two men in somewhat different form[5]. It shows the comfort zone where heat loss was balanced with heat production by easy minor changes in blood flow in the skin or slight increases in vaporization. Above this point, there was a marked increase in peripheral blood flow and a marked rise in the curve of vaporization. The conductivity or conductance of the skin increased with increased blood flow.

Below the comfort zone, the blood flow to the skin shut off abruptly when the skin started to become cold. The skin no longer served as an active heat interchanger, but instead took over the function of a thin suit of leather clothing.

It will be noted that in the cold the skin temperature fell in proportion to the stress, and served as an excellent indicator. Above the comfort zone, however, the skin temperature was not an indicator of stress, because the skin was kept at a fairly uniform temperature through the vaporization of sweat.

There are a good many lessons that can be learned from this chart. If, for example, the heat production of the man had been raised above the basal level, the comfort zone of easy balance would have been shifted to a cooler region. If instead of being naked, the man had been dressed, the heat loss would have been close to the heat production at a lower temperature. On the other hand, if the air movement in the calorimeter had been increased, and with it the heat loss by convection, the comfort zone would have been shifted to a warmer level. If, the walls of the calorimeter had been constructed as radiant panels, the heat loss by radiation could have been blocked or augmented, causing wide changes in comfort.

The regulation of body temperature is a complicated matter. There seems to be a rough control by a thermostat at the base of the brain which responds to blood temperature. A more delicate control with feed-backs is found in the skin, which, incidentally, can detect changes of 0.004 deg C in three seconds. Comfort is purely a matter of sensation, and human sensation is delicate, acute, subject to acclimatization, habit, and other individual differences.

In the comfort zone, the adjustments through slight changes in peripheral blood flow and slight increases in vaporization are made so easily that they do not enter our consciousness. Above and below this zone, the adjustments begin to enter our

consciousness. If too hot, there is uncomfortable sweating; if too cold, the skin warns us that we should exercise, seek a warmer spot, or put on more clothing.

Until the beginning of this century, almost everyone was cold in winter, but managed to get along with winter underwear and stoves. In the last few decades with our technical improvements, our houses and public buildings have grown warmer and warmer.

There is one dangerous element in overheating that has been emphasized in recent studies of Arctic clothing. If a heavily clothed man in the Artic exercises hard without taking off or opening his clothes, he will begin to sweat, and sweating is a major hazard (page 414 of Reference 3). The extra water vapor will condense in the cold layer of clothing and give back some of the heat of condensation to the body. When the man stops exercising, the insulating properties of the clothes are impaired, and heat loss is increased by the additional vaporization from the damp clothing. The same thing in lesser degree can occur when going from a warm to a cold room. This introduces an error when comparing comfort impressions on changing suddenly from one experimental chamber to another.

It certainly is a mistake to overheat stores and cars when people are wearing overcoats. There is probably a great deal of overheating of dwellings. Although some of the older generation are tough and well accustomed to cool rooms, there are many elderly people whose low level of heat production makes them prefer hot rooms. Usually in the household it is the senior member, the little old grandmother, who dictates the temperature of the house. Here is an opportunity for a better study of local heating. If there is no open fire could you provide an electrically heated armchair? Why overheat 100 tons of house and furniture, when all that is necessary is to warm 100 lb of grandmother?

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1. Temperature and Human Life, by C.-E. A. Winslow and L. P. Herrington (Princeton University Press, 1949).

2. Basic Principles of Heating and Ventilating, by T. Bedford (H. K. Lewis and Co., Ltd., London, 1948).

3. Physiology of Heat Regulation and the Science of Clothing, by L. H. Newburgh (W. B. Saunders Co., Philadelphia and London, 1949).

4. Mechanism of Heat Loss in Health and Disease, by E. F. DuBois (*Transactions, Association of American Physicians*, 51:252, 1936). See also, Lane Medical Lectures, The Mechanism of Heat Loss and Temperature Regulation, by E. F. DuBois (Stanford University Press, 1937, p. 348).

5. Heat Loss from the Nude Body and Peripheral Blood Flow at Temperatures of 22 C to 35 C, by J. D. Hardy and G. F. Soderstrom (*Journal Nutrition*, 16:493, 1938).

Engineering Aspects of Comfort Data

By Charles S. Leopold

CHARLES S. LEOPOLD, Philadelphia, Pa.—Consulting engineer. Received his B.S. and E.E. in 1917 from the University of Pennsylvania. Has been in private practice as a consulting engineer since 1925. Currently is serving as a member of Council and in 1945 served as chairman of the Guide Publication Committee, following several years as a committee member. He is a Fellow of ASRE and was president in 1946.

This discussion is based on subjective testing. The occupants of an office building are the last court of appeal in judging the acceptability of an environment. If they think the office is too warm, it is too warm for them. If they think it is too cold, it is too cold for them. No amount of instrument readings can change this fact. When people say they feel cold it may be due to temperature or it may be due to draft or it may be due to radiation effects or to their physical condition. If they say they are too warm it may be due to radiation effects or temperature or humidity. The average person does not judge these factors separately. I suggest that for actual installations, the criterion should be: What conditions are acceptable to the greatest number who do not have to pay for the maintenance of these conditions, and who are unaware that a test is being conducted? For house heating, if the master of the house must pay a high fuel bill, he quite likely will find an optimum which compromises with his pocketbook. His guests will be just plain cold. In any building, if the subjects know that a test is being conducted, they tend to interpret their sensations and are likely to report how they think they should feel.

There being no clear definition of comfort, I have chosen to define it as *The absence of discomfort or annoyance due to temperature and atmospheric effect indoors.* I believe it is safer to think in terms of eliminating discomfort than it is to think in terms of building a nebulous condition called *comfort.* By the discomfort approach, we avoid confusing our thoughts by bringing into consideration such things as stimulation and health, and we further avoid the confusion caused by trying to find a fictitious optimum, which is in reality a measure of how much overcooling or over-heating we can stand without being too uncomfortable. The time may come when someone may prove that we should be uncomfortable for the sake of our health but the burden of proof will lie heavily on anyone who advocates such a change.

This discussion applies principally to the activities noted in the second and third bars from the left of Fig. 1. Unless otherwise stated, they will apply to office workers in the northern part of the United States, although the changes for the southern part of the United States are relatively small. The subjects considered will be of age 18 and above, and the space will be considered as being conditioned by a ventilating system of adequate capacity and air motion, not exceeding 20 fpm. Mean radiant temperature is assumed to be the same as the air temperature.

The work of the Society started in 1923 under the direction of the late F. C. Houghten, then ASHVE Research Director, and continuing under his direction until 1942 when he obtained a leave of absence to join the armed forces.

The development of the effective temperature concept marked a real turning point in our knowledge of thermal environment. Combinations of temperature, humidity and air movement which induce the same feeling of warmth are called *Thermo Equivalent Conditions.* When shown in chart form they are called lines of *effective temperature.* The concept, though at times challenged, remains today the single most acceptable criterion. The old saying, *it isn't the heat, it's the humidity* is not correct. It is both the heat and humidity. In summer an increase of 5 to 7 percent relative humidity is equivalent to a rise of 1 deg in temperature. For these tests, two rooms were equipped so that the subjects could pass from one room to another and record the sameness or difference in their sensation of warmth. From these and similar tests the effective temperature lines were developed. There has been some question as to the effect of time of acclimatization and the possibility that there is some difference between several hours of acclimatization and, let us say, one-half hour of acclimatization. There has also been some question whether or not humidity had a greater effect at high temperatures and a lower effect at low temperatures than the Society's work would indicate. Some modification of these lines may be in order but the basic concept and the order of magnitude remain substantially unchallenged.

Following the determination of the effective temperature lines, tests were conducted to determine the optimum condition for a group, in both summer and winter. This work was incorporated in several types of charts and in 1929 was published in the form of Fig. 2. In this presentation the comfort zone is shown as the area between conditions where everyone is too cold, everyone is too warm. Optimum summer comfort was shown at 71 deg effective temperature which at 50 percent relative humidity corresponds to 76 F and this still remains the accepted standard. The winter line was shown as a 66 deg effective temperature which at 30 percent relative

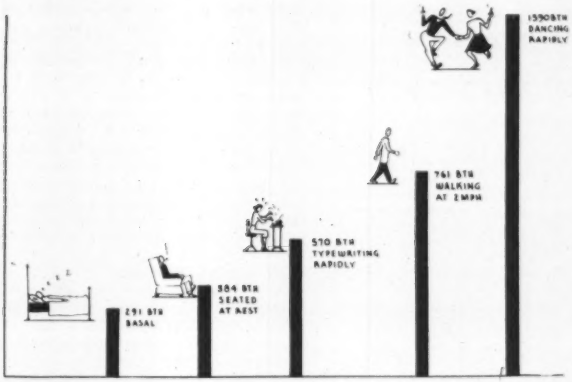


Fig. 1—Relation of heat output to activity

humidity indicates 72 F room temperature, and this finding has been questioned, apparently with cause as will be subsequently shown.

In 1932 the Society modified its chart to the form shown in Fig. 3. Percentages of people feeling comfortable were eliminated and a comfort zone was added to indicate the area where 50 percent of the people would be satisfied with the effective temperature. It was frequently misused and the apparent belief was that anything within this zone was acceptable. It is a curious use of the word *comfort* to have it describe a condition in which 50 percent of the people experience discomfort.

In 1938, in an effort to simplify the presentation of the comfort chart, the author prepared the discomfort chart, (Fig. 4) based on the Society's data as shown in the 1929 chart. The winter data line took a form which would not be expected from statistical data; that is, it had a sharp point of inflection on the cool side. (In 1945, there was added a line called *The new data*, based on some work of the Laboratory in 1941.)

In these series of tests, which were primarily to determine the effect of radiation, they had found an apparent shift in the winter optimum comfort line. I called this question to the attention of the Society and Prof. Glickman decided to investigate. He found that the actual result was 2 deg ET higher than shown on the 1932 chart.

The underestimate is probably due to the inclination of people to think that there is some virtue in enduring cold indoors. It is also conceivable that there were many people, wedded to the 70 F concept, who were having difficulty in accepting the 72 F concept, much less a dry bulb temperature of nearly 74 F.

Based on the test work of Mr. Houghten in 1941 and the re-analysis by Prof. Glickman, and the Society's approval on the basis of a paper* presented in 1947, THE GUIDE 1950 carries the chart in the form shown in Fig. 5. Although the amount of information shown on this chart has been reduced, I believe that what remains can be more safely accepted. The winter optimum is now approximately 74 F at 30 percent relative humidity; a total change of about 2 deg dry bulb, which may be accounted for in part by error in the original presentation and in part by change in clothing. A picture of the group which participated in the early tests indicates longer skirts and heavier clothing than is customary today. There has been no reason to question the summer optimum condition.

The thought that an appreciable percentage of people will be dissatisfied, regardless of conditions, is not supported by observation of systems properly designed and operated. In drawing conclusions from field experience, however, it is advisable to exclude from data systems in

*Conditions for Comfort, by Charles S. Leopold

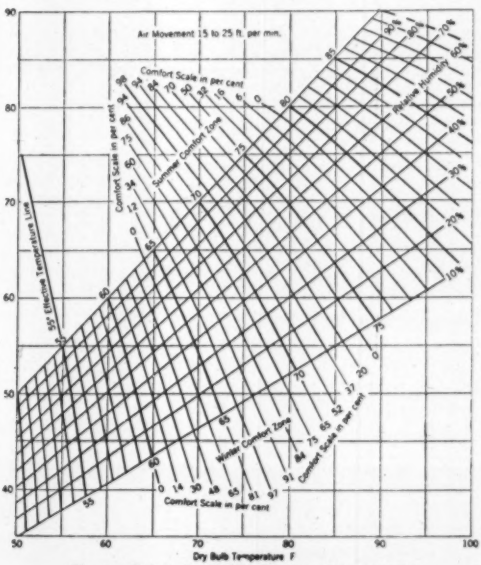

Air Movement 15 to 25 ft. per min.
Comfort Scale in per cent
Summer Comfort Zone
Winter Comfort Zone
Relative Humidity
55° Effective Temperature Line
Dry Bulb Temperature F

Fig. 2—Original ASHVE Comfort Chart (1929)

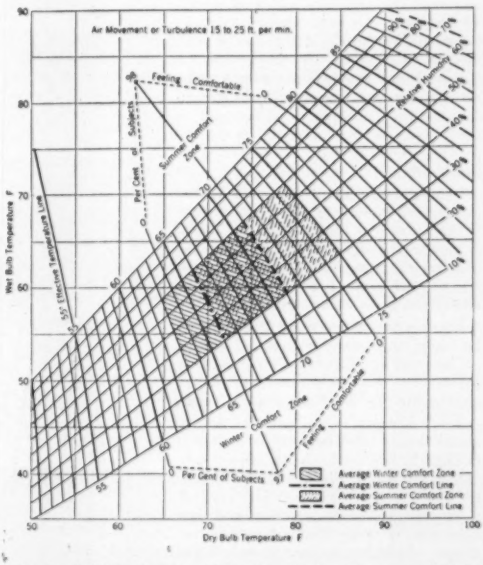

Air Movement or Turbulence 15 to 25 ft. per min.
Feeling Comfortable
Per Cent of Subjects
Summer Comfort Zone
Winter Comfort Zone
Relative Humidity
55° Effective Temperature Line
Wet Bulb Temperature F
Dry Bulb Temperature F
Average Winter Comfort Zone
Average Winter Comfort Line
Average Summer Comfort Zone
Average Summer Comfort Line

Fig. 3—ASHVE Comfort Chart showing comfort zone (1932)

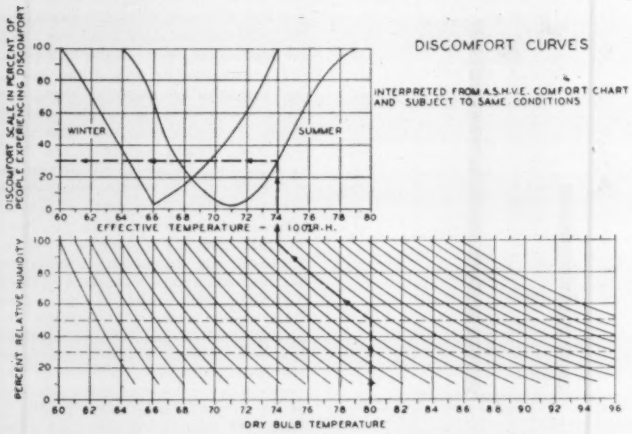

DISCOMFORT CURVES
INTERPRETED FROM A.S.H.V.E. COMFORT CHART AND SUBJECT TO SAME CONDITIONS
DISCOMFORT SCALE IN PERCENT OF PEOPLE EXPERIENCING DISCOMFORT
WINTER
SUMMER
EFFECTIVE TEMPERATURE — @ 100% R.H.
PERCENT RELATIVE HUMIDITY
DRY BULB TEMPERATURE

Fig. 4—Discomfort Chart prepared by author (1938)

which: (1) the draft problem has not been thoroughly solved, (2) there are pronounced unbalanced radiant effects, or (3) constant conditions cannot be maintained throughout the day because of limited capacity.

If laboratory work does not agree with the mass experience, we should then question either: (1) the laboratory technique, or (2) the mental process whereby the results of the laboratory are applied to everyday living.

Since individuals differ with regard to physiology, work and rest habits, and food and drink habits, there can be no condition which is optimum for all people at all times. We can, however, find the conditions which offer the minimum discomfort to a group; in other words, a statistical optimum. This leaves us in the position that we have very specific knowledge of optimum conditions for a group but far less certainty as to the optimum condition for any one person in that group.

Experiments in the laboratory indicated a range of 6.5 deg to cause the average individual to pass from a feeling of *slightly cool* to *slightly warm*. Why, then, the need for the very close tolerance of possibly plus or minus 1 deg which must be established in an office structure?

Fig. 6 is an attempt to explain the need for close temperature control by showing an assumed distribution of subjects, each having the same tolerance but not occurring over the same temperature range.

There appears to be a little lack of clarity as to the importance of minor changes in relative humidity, temperature, and radiation. In Fig. 7 I have attempted to show that we properly cannot evaluate a variable under one condition and then generalize as to its effect in another condition. Referring to this curve, if you are at the optimum, either summer or winter, and make a change equivalent to 1 deg effective temperature, it will cause only a small percentage of individuals to note a change in their sensation of warmth but, if referring to the same line, a condition of 78 F is being maintained, a large number of individuals is affected. It would appear that if an optimum condition is being maintained, a small departure will be of minor significance.

In dealing with sensation, I believe the psychologist would tell us that man responds to his environment as a whole, rather than in a way which can be predicted by a knowledge of the separate variables which go to make up his environment. This is by no means to imply that we cannot and should not gain all possible knowledge of the effect played by separate variables but it is to caution that we must take nothing for granted unless verified by subjective testing; *i.e.*, from the opinion of the occupants themselves.

Of late, emphasis has been placed on mean radiant temperature. We are all familiar with the fact that it is difficult to cause a large difference between air temperature and mean radiant temperature in a heated structure and that usually some exceptional means must be employed to produce a marked difference.

There is, however, another radiation effect which is of primary importance, namely, that due to asymmetry of radiation. For example, if an office worker has her back to a window, approximately 3 ft away, on a cold day she will have an accelerated loss of heat to the window by radiation. If there is a radiator beneath the window, she will have a net gain of

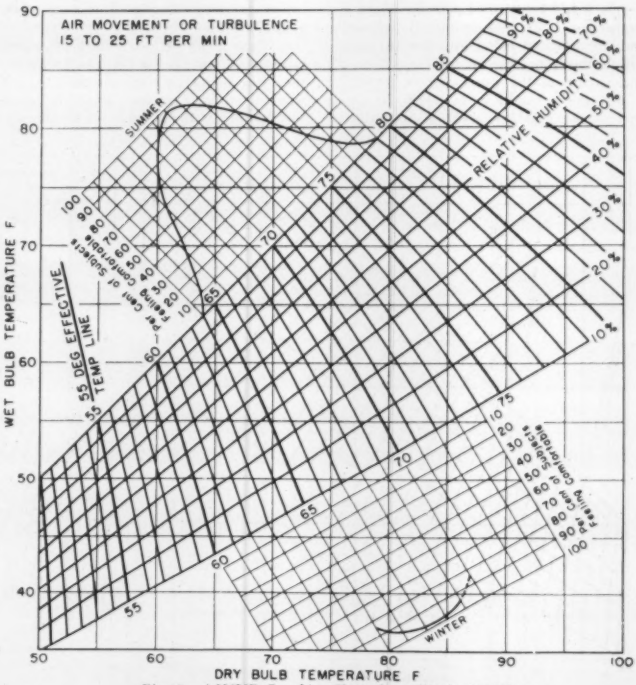


Fig. 5—ASHVE Comfort Chart for still air (1950)

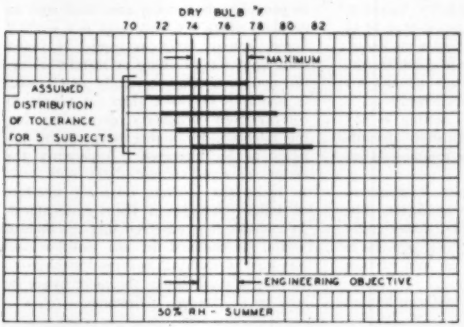

DRY BULB °F
70 72 74 76 78 80 82
MAXIMUM
ASSUMED DISTRIBUTION OF TOLERANCE FOR 5 SUBJECTS
ENGINEERING OBJECTIVE
50% RH - SUMMER

Fig. 6—Illustration of relation of group to individual tolerance

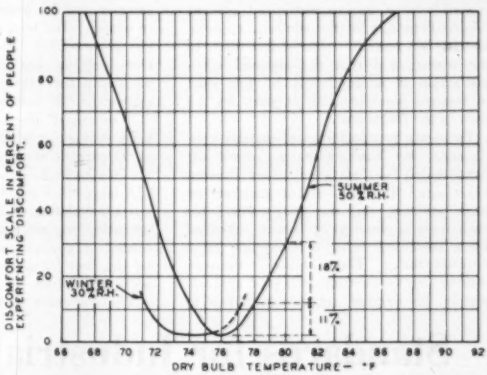


Fig. 7—Discomfort curves interpreted from ASHVE Comfort Chart

heat from the radiator and these two factors can frequently be made to compensate satisfactorily. Without a radiator, she would feel cold even though the thermometer on her desk showed an optimum temperature and would not be free of discomfort even if the air temperature were raised.

It was once considered advisable to vary the indoor temperature in accordance with the outdoor temperature from hour to hour.

Many people believe that the inside conditions for office buildings should be controlled in accordance with variation of the outdoor temperature, and that the interior should either be maintained at a fixed differential with the outdoors or on some predetermined relations. Plausibility seems to be the only support for the theory, but I do not see why it is plausible to think that a person arriving at work on a cool morning should have the temperature of the building raised hour by hour during the day when, for his part, he does not know what the outside temperature is. We have previously shown that there cannot be an appreciable departure from the statistical optimum without creating discomfort.

Experimental work has shown that if a person who is perspiring enters an air conditioned structure it makes very little difference in the end effect whether that building be maintained at 80 F or at 76 F.

In the discussion of ASHVE Research Paper No. 1055, presented in 1937, Mr. Houghten gave in Fig. 8 the results of tests obtained by measuring the rate of evaporation from a metal cylinder enclosed in a wetted cloth. These tests were conducted at the same effective temperature, one cool and moist, the other hot and dry, and under each condition with one series of tests with heat for evaporation supplied by the air only, and the other when the heat for evaporation was in part supplied by heating the cylinder. It is to be noted that in Tests 3 and 4, when the cylinder was heated, there was comparative little difference in the rate of evaporation, and this heated cylinder is a better approximation of a clothed human than is the unheated cylinder. The experiment was performed to substantiate Mr. Houghten's statement that the clothed human body is relatively little affected in its rate of evaporation of moisture from its surface by rather wide variations in the relative humidity of the atmosphere under conditions of equal effective temperature. Experiments of this type may be of interest in determining a physical interpretation of the meaning of effective temperature.

The practice of raising the inside temperature is sometimes advocated by those who fear the so-called *exit shock*. Bad effects of this *shock* have not been demonstrated even for people having cardiovascular difficulties. Many people enjoy a so-called *entrance shock* on a hot day.

The fact that it has been found unnecessary to vary the inside temperature of a building from hour to hour emphasizes the point frequently overlooked by designers but seldom by the operating engineer, and illustrated in Fig. 9. It is found that a thermostat setting of approximately 75 F will suffice for year-round

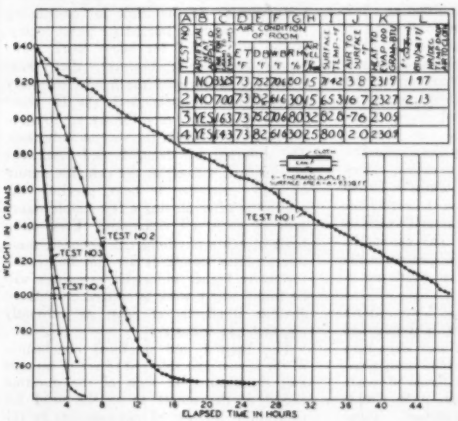
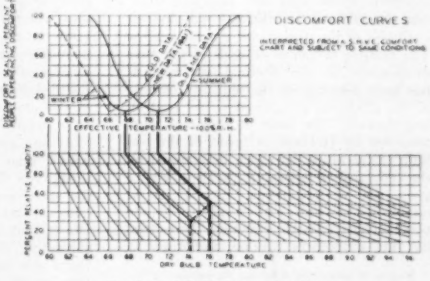


Fig. 8—Evaporation from wetted cylinder enclosed in wetted cloth

Fig. 9—Revised Discomfort Chart prepared by author (1943)



Based on ASHVE Research—1941

operation with approximately 50 percent relative humidity in the summer, approximately 30 percent relative humidity in the winter, and that the seasonal acclimatization is accomplished by this shift in relative humidity and, in part, by the drift in the thermostat.

There are two buildings of massive construction in Washington in which air conditioning was installed about thirteen years ago. In each, air is supplied by large systems, and the final control for each room is obtained by reheat controlled by a thermostat with a temptingly large adjusting knob. The moisture of the conditioned air is controlled to give approximately 50 percent relative humidity in summer and 30 percent relative humidity in winter. The total occupancy (age 18 to 80) is over 2000. Air motion is moderate. One building has radiators beneath the windows; the other depends on the air system for all heating requirements.

A census of the control setting at any time, summer or winter, will show upwards of 90 percent of the room thermostats set for 75 F to 76 F.

A large office building, near Washington, has a population of 25,000 to 35,000. The operating engineers find that a thermostat setting of approximately 75 F appears to be the best for both interior and exterior zones year-round.

The discussion thus far has been limited to people in the activity associated with an ordinary office. Where there is a slightly higher activity, such as would be found with light woodworking or metal-working, the optimum, when carefully determined, is found to be lower than for people in comparatively sedentary occupation but the tolerance for higher temperatures appears to be increased. Apparently the factors of standing and slight work tend to make the workers relatively unaware of minor changes in their environment. In general, it is observed that the more a person is confined in one position and one type of clothing, and the less occasion he has to move about, the more aware he will be of thermal environment.

Standards for Industrial Heat Control

By Theodore F. Hatch

THEODORE F. HATCH, Pittsburgh, Pa.—Professor of industrial health engineering in the Department of Occupational Health in the Graduate School of Public Health at the University of Pittsburgh, and Laboratory Director of Industrial Hygiene Foundation — Professor Hatch is a Senior Fellow at Mellon Institute. He received his B.S. in civil engineering from the University of Maine, his S.M. in sanitary engineering from Harvard. In 1936 he became associate dust control engineer, Division of Industrial Hygiene, New York Department of Labor, and in 1940, he joined the staff of the School of Medicine, University of Pennsylvania, as associate professor of industrial hygiene. For his service in World War II, Professor Hatch was awarded the Legion of Merit in 1946.

The ill-effects of heat are widely recognized in industry, as evidenced by the progress which has been made toward its elimination as a stress factor of consequence in the working environment. Acute effects of extreme exposures have all but disappeared in the traditional hot industries and even in those industries having no unusual heat production, comfort-conditioning is becoming common. It is mainly a question of cost, apparently, which limits the rate of continuing progress in the control of industrial heat. What, then, is the remaining problem of interest to physiologists and other investigators? Is there a need in industry for further research study of man's behavior in hot environments or is it, indeed, only necessary to treat the problem now in terms of engineering and simple economics?

In the higher region of acute physiological response to heat, extensive laboratory investigations and industrial experience have established practical limits of tolerance. No doubt, interesting and important researches on certain aspects of the acute problem have yet to be made, but for the practical purposes of industry, present values for tolerance limits are quite adequate. It is known that the safe level of exposure varies with the rate and duration of work and that the age and physical condition of the worker are critical factors. The relative influence of each of the four components of the thermal environment has been determined, the moisture content of the air being recognized as the controlling factor. The limit of tolerance, first proposed by Haldane in terms of the wet bulb temperature, has been determined on the effective temperature scale. For a given set of conditions, Eichna[1] et al established a line with a slope on the psychrometric chart between these two, but the differences are not important in practical industrial application. The effective temperature scale can now be corrected for the important factor of radiant temperature in the hot industries and the benefits to be had from radiation screening are receiving increasing attention. The regular intake of salt has become routine practice; the needs for proper selection and supervision of workers in hot environments are matters of common knowledge. In effect, cases of extreme heat exhaustion and death, once quite common in the traditional hot industries, no longer occur except under the most unusual circumstances.

At the other extreme, the limit of the simple comfort zone has been even more firmly established and its practical usefulness demonstrated in extensive and costly installations. It provides a satisfactory basis for the engineering design of control measures for comfort-conditioning but these are largely limited in application to those industries where natural climatic heat, rather than process heat is of concern and where the work is characterized by highly concentrated attention, involving considerable skill and mental effort. Comfort-conditioning represents the ultimate goal, bringing about as it does, effective elimination of any heat problem. This ideal thermal standard has little practical value in the hot industries, however, for it requires a degree of control which is economically beyond reach and cannot be justified by any quantitative measurements of the ill-effects of heat now employed in such industries.

At one extreme, then, we have criteria based upon the clear-cut physiological breakdown from excessive heat exposure; the other boundary has no important physiological basis, at least in terms of acute effects, but is based, rather, upon simple subjective evaluation of comfort. These limits are shown as effective temperature lines on the psychometric chart in Fig. 1 and it is at once apparent how extensive the area is between them. With the acute physiological effects largely controlled, the industrial situations of concern now fall within this region which, however, is not well charted in respect to thermal standards. That is to say, there are no established benchmarks comparable to the limiting boundaries of comfort and of physiologic tolerance which can be used as guides for determining just how much further a particular industry should go in the control of heat beyond the elimination of immediate, acute effects. In a recent report of the *APHA* Committee on Atmospheric Comfort[2] two intermediate standards of exposure are suggested: 85 ET (effective temperature) as the limit for continuing light work without immediate physiological strain and 80 ET for heavy work. The report emphasizes, however, that these limits are based upon the most elementary physiological criteria and should serve only as guides for establishing appropriate working standards in the various industries. The differing job demands and conditions of exposure, as well as the complex nature of man's response to heat, preclude the possibility of employing a few simple standards to cover all situations. Even on a basis of acute physiological response, these intermediate standards are not impressive for many higher industrial exposures will be found where work is carried on without obvious ill-effects, at least as presently measured in industry.

The limited and qualified conclusions of the report just referred to are of interest and significance in view of the question raised at the outset as to the need for continuing interest of physiologists in the industrial heat problem. Despite the extensive study which has been given to this

[1]Exponent numerals refer to References at the end of this presentation

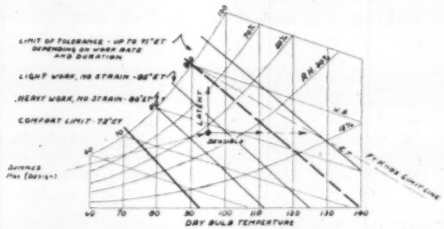


Fig. 1—Limiting conditions based on comfort and on physiological tolerance

Limiting lines of comfort and of acute physiological tolerance, showing extensive uncharted region on psychrometric chart between them. Typical maximum climatic condition plotted for reference.

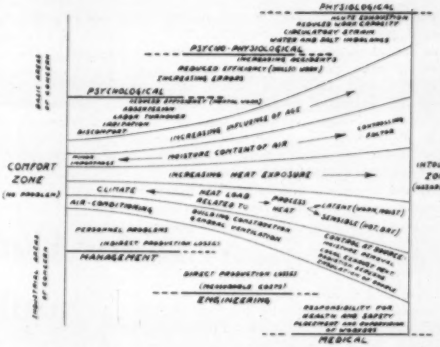


Fig. 2—Basis of industry concern in worker's environment

Diagrammatic outline of heat effects in region between limits of comfort and acute physiological tolerance, suggesting three overlapping subdivisions of basic interest and parallel divisions of concern within industry.

subject over many years, the report suggests that engineers do not find in the existing body of information too much guidance in setting up procedures for the quantitative appraisal of heat effects below the acute physiological level or to assist them in reaching decisions as to the degree to which control should be extended in each case. The need exists then, for physiologists and experimental psychologists to assist in establishing the additional thermal standards which are required in industry to cover the extensive region of environmental conditions lying between the upper limit of physiological tolerance and the lower limit of simple comfort.

Useful information is available, perhaps, from other areas of study (especially military) which has not been especially evaluated in relation to industrial situations. Experimental technics are also developed which have application. Mackworth's study[3] of frequency of errors of wireless operators in relation to level of heat exposure is an illustration of a procedure in experimental psychology having useful application to industrial studies. In short, some of the future work, at least, of physiologists and psychologists interested in this particular area should be oriented, specifically toward the industrial problem.

To indicate in broad outline the complex nature of the heat problem in industry, the diagrammatic sketch in Fig. 2 has been prepared. It attempts to show the varying nature of the problem between the comfort zone on one side and the intolerable zone on the other and to suggest the ways in which the effects of heat at varying levels of exposure differ in importance from one industry to another. Its purpose is to suggest a basis for further research and appraisal of heat effects in industry.

Between the two limits, the pattern of human response to heat covers the range from dramatic, acute effects through a region of lesser physiological manifestations which overlaps with a zone in which interest shifts from physiological to psychological stress of decreasing magnitude as the comfort zone is approached. Three overlapping subdivisions — physiological, psycho-physiological and psychological — are suggested. At the upper limit the cost of heat is measured in terms of life itself. With lesser levels of exposure, immediate danger to life is replaced by long-term physiological effects, resulting from repeated exhaustion, increased heart strain and the like, which are tolerated by some but may have disastrous effects on others. The capacity for manual work is reduced and accident rates are higher than in cooler environments. These direct hazards to health and safety disappear with further lowering of exposure level and it becomes necessary to measure heat effects in the more subtle terms of psychology. In its higher manifestations, psychological stress results in direct loss of efficiency, increased frequency of error in job performance and the like. At such levels of exposure the capacity for simple manual labor is not seriously impaired and psychological effects are of importance only in the performance of more demanding tasks. The magnitude of thermal load at which demonstrable psychological stress appears is lowered as the job increases in complexity and reaches the comfort zone when long-continued mental concentration is involved. For less demanding tasks, response to heat in the region immediately above the comfort zone takes the more elementary form of simple discomfort and irritation. Cost at this level is best measured, perhaps, in terms of human relations.

It is clear from this brief sketch that there are marked differences in the nature of heat effects and that costs must be measured with different yardsticks at the various levels of exposure falling between the extreme limits of comfort and maximum tolerance. It is equally clear that these physiological and psychological measurements differ in value from one industry to another, depending upon the relative importance of simple manual labor compared with skilled tasks. Criteria for establishing thermal standards vary in respect to the seriousness of effects upon the exposed workers. At the higher levels, suggested by the zone of physiological effects on the diagram, there is real danger to health and safety, and industry must avoid such hazards at any cost. One must recognize, in this connection, the possibility of long-term and indirect effects of heat as well as the obvious acute effects, and it is important that these be fully understood in order that proper safety limits may be established. In industry, however, one finds little continuing medical interest in the long-term effects once the acute situation is taken care of effectively. A common reply today to an inquiry concerning the heat problem in one of the traditional hot industries is that no problem exists because there has not been a death or case of heat exhaustion in, say, 15 years. There is no routine or special study of men on hot jobs; they are seen only when they come to the dispensary for other reasons. Thus, there is no accumulating information by industrial medical departments on the long-term effects, if any, of sub-acute heat exposures. In clinical terms they have no basis for making special observations on these workers so long as they register no specific complaints or show no acute effects.

In the middle zone and below, no health hazard of consequence is involved and hence, no responsibility exists under the laws of industrial health and safety. Here, the efficiency and cost of production and, finally, the general well-being of the worker become the primary factors in determining the cost of heat exposures and in setting standards or, rather, the objectives of heat control. At the higher levels of exposure in this zone, loss in efficiency may be directly measurable but in environments of lesser severity, heat effects are indirect and are measured with increasing difficulty.

The differences in areas of concern within the industrial organization are also

suggested in Fig. 2. The upper region is one of primary medical responsibility, and as stated above, hazards to health and safety take precedence over costs. The middle zone falls best within the province of industrial engineering with opportunities for measurement of the cost of heat exposure in terms of direct production losses, increased errors, excessive rejects, lowered quality control, and the like. In the lowest sub-division, just above the comfort zone, the moderate ill-effects are of primary concern to the personnel department.

The three subdivisions suggested in the diagram must not be taken as having definite separating boundaries. They overlap in a degree which varies with the type of industry and nature of the work. Further, one cannot think of establishing thermal standards within these zones based upon real end-points such as were used to fix the limits of comfort and maximum tolerance. That is to say, an individual is or is not comfortable and, similarly, the presence or absence of acute physiological strain can be demonstrated by measurable indices. Between these two limits, however, changes are gradual rather than abrupt, and the difference in heat effects can only be expressed on sliding scales. There is a practical need for these scales to provide a quantitative basis for measuring heat costs which are to be balanced against the cost of heat control, thus providing industrial engineers with a factual basis for design in place of an ill-defined desire to reduce heat exposures.

In closing this brief statement of needs for an extension of thermal standards in industry, I should like to refer again to the *APHA* report. To quote:

"Among the criteria now in use for evaluating the suitability of thermal environments for work, or rest, are the comfort and health of individuals, their work output, and their physiological and psychological reactions to work. *There is no objective index for general application; the variables are many and cannot be quantitatively evaluated at present.*"*

And in the conclusion of the report:

"Responsibility for establishing practical standards rests largely with individual industries concerned with heat and cold. A few large industries have done their share of study and experimentation; others still lag behind. The committee will be fully recompensed for its effort if this report would stimulate greater interest in field work and dissemination of practical information, which is very much needed for revising the report in the future."

It is fair to say that the investigative skills needed for further study of the heat problem along the lines indicated are not generally available in industry. The problem, then is one of cooperative investigation in the factory more than in the laboratory requiring research physiologists and psychologists to supplement the skills and special knowledge available in industrial medical, engineering and personnel departments.

*Italics are by author.

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3. Definition of the Upper Limit of Environmental Warmth by Psychological Tests of Human Performance, By N. H. Mackworth (Report *Royal Society Empire Scientific Conference*, June—July, 1946, 1, 423, 1948).

Air Conditioning in the Treatment and Prevention of Disease

By Robert W. Keeton, M.D.

ROBERT W. KEETON, M.D., Chicago, Ill.—Head, Department of Medicine, University of Illinois. Previously Associate Professor of Medicine; Professor of Medicine, Acting Head of Department of Medicine, at the University of Illinois. Head of Department of Medicine since 1934. Received degree of A.B. from Cumberland University, Millikin University, and University of Chicago; M.S. from University of Chicago; and M.D. from Northwestern University.

Respiratory tract infections and, more specifically, the common cold, cause so much morbidity in individuals and economic loss to society that they have become a major public health problem. Since the infected individual is generally sniffling, blowing his nose, and coughing with varying degrees of violence, it is natural to conclude that he is seeding the air with infectious agents which will be speedily passed to others. At first glance, sterilization of the air would appear to be a logical preventive measure.

The American Society of Heating and Ventilating Engineers, the *American Public Health Association*, and the *National Research Council*, through their appropriate committees, have studied the various aspects of this problem and issued authoritative reports. Under controlled experimental conditions, radiation with ultra-violet light and the vapors of tri-ethylene glycol have been found to exert lethal action against a wide variety of air-borne infectious agents. The application of these two methods in field tests have not shown statistically significant reductions in respiratory infections. They have been found to be useful adjuvants to aseptic technique in the reduction or elimination of air-borne infections in operating rooms, in contagious wards and in pediatric wards.

The methods by which respiratory infections are transmitted from one individual to another are not completely known. Thus, if an individual, by coughing, deposits infectious agents on the conjunctivae, mouth or nose of another person, this is a contact transmission. If the coughing or blowing of the nose deposits droplets of bacteria and viruses on the bed linen, floor, furniture or the clothes of another individual, the moisture surrounding these agents is evaporated and they become incorporated into dust. From this dust, the infection may be transmitted to others.

Transmission of infection by dust is considered by some authorities as air-borne transmission. This view is difficult to defend since dust particles are usually large and once they have come to rest in a room are rarely again suspended in the air for any appreciable time. It would probably be simpler to say that this is a dust-spread infection. If the infectious agents in their expulsion into the air are attached to droplet nuclei which are less than 100 microns and much smaller in size than droplets, they will remain suspended in the air for considerable periods of time. If the inhalation of these suspended droplet nuclei with their infectious agents produces a respiratory infection, then this infection is air-borne.

In the experiments in which ultra-violet radiation and glycol vapors have demonstrated lethal effects on infectious agents, these agents have been suspended in the air in the form of nuclei of small diameters. In this state they are truly air-borne and these agents have effected a sterilization of the air.

This definition of droplet nuclei, their association with influenza virus, and destruction by ultra-violet radiation, have been discussed by Wells. Duguid has studied exhaustively the origin of the large droplets which rapidly fall to the ground and the small droplet nuclei which remain suspended, their method of formation, their relative frequency, and their relationship to infectious agents. He concludes that the large droplets commonly carry the infectious agents. The droplet nuclei are so small that only a relatively few of them carry bacteria or viruses. The likelihood of transmitting bacteria varies directly with droplet size. The small nuclei are commonly atomized from the anterior portion of the mouth in which very few pathogenic bacteria reside. The pathogens are normally found in tonsils,

fauces, pharynx, nose and bronchioles. They are associated with the release of large droplets. Similar conclusions were reached by Hare and MacKenzie using different methods of investigation.

This leads to the conclusion that respiratory infections are spread by primary contact or secondary contact through dust. Sterilization of the air or air-borne infectious agents is not profitable because of the destruction of only a small number of organisms. When ultra-violet radiations and glycol vapors are directed against the dust, they are less effective because the organisms are protected by their location, their desiccated state and the accompanying lint and dirt. The treatment of bed linens and floors with various types of oily products has been found to be more effective in eradicating dust.

One may now return to the original question which concerns the value of air conditioning in preventing respiratory infections. Certainly, the reports that have been carried out and the studies on straight air conditioning have been rather disappointing, we should say. Colds persist in spite of office workers being in air-conditioned buildings. This, of course, is understandable because of the wide variety of times in which they are away from the building and the exposure. It seems generally agreed then that bacteria and viruses are more vulnerable when suspended in an atmosphere with 50 percent to 60 percent humidity than in lower humidities. The latter condition is one which not uncommonly prevails in the winter months in the average apartment or house. The nasal mucosa with its extension into the sinuses is richly supplied with small blood vessels whose size is controlled by the vasomotor nerves. The alteration in the rate of secretion of mucus in response to changes in blood flow may block the small drainage pathways and trap potentially infectious agents in the nasal cavities. These in turn are easily absorbed and start a syndrome which may manifest itself as a head cold. Convection currents (drafts) or cold radiation effects, which strike the exposed portions of the body, commonly set up vasomotor reflexes which may set off the chain of events referred to above. In other words, I think we can't throw out the old adage we run against that you don't want a draft on the back of your neck if you want to avoid a cold. One excellent procedure in treating a cold is to go to bed and keep the body uniformly warm. If a person does that, they get along fine. It is a matter of keeping the entire body uniformly warm.

Hence, whatever advantages come from an air-conditioned space, it should be free of draft and sites of cold radiation which would prevent the tripping of the trigger mechanism.

Finally, the best precaution for a cold is to keep the individual in good health, avoid fatigue and exhaustion. The work of Kerr and Lagen is of interest on this point. They have shown that susceptible individuals exposed continuously to a temperature of 70 F dry bulb, and 60 to 62 F wet bulb, did not acquire a common cold when subjects with acute colds were confined to the same room for 24 to 48 hours. During this time the subjects with colds coughed and sneezed without restraint. The same water glasses were used, and playing cards were handled interchangeably. Attempts to inoculate the conjunctivae of the experimental subjects with nasal secretions taken from those with colds also failed. The conclusion was reached that the syndrome of the cold depended largely on the physiological state of the host and that it was not transmissible under the conditions of the experiment. Your air conditioned space may be helpful in this respect.

It seems desirable at this point to discuss conditions under which it has been established that air conditioning is of therapeutic value and the rationale for its effectiveness.

Man is a homeothermous animal whose body temperature varies within rather narrow limits. This relatively constant temperature results from a dynamic equilibrium between heat production and loss. The lower limits of rectal temperature at which a patient may live for an appreciable length of time and later be revived was shown by Fay and Smith to be 88 to 90 F. The upper limits are 107 to 110 F, but at such temperatures life can be maintained for only relatively short periods of time and only then if sufficient fluid is administered to prevent dehydration and anoxemia prevented. Beyond these limits irreversible changes occur in the biological systems concerned in the mobilization and transfer of energy. It would seem to be an obvious corollary that the optimum temperature at which these systems work is that found in the normal afebrile individual. Perhaps one of the most generally recognized symptoms of disease is fever, and the layman is convinced that he is sick when an elevation of his oral temperature is discovered.

The problem for discussion may now be restated. Just how can a conditioned atmosphere prevent or correct aberrations in body temperature? The fundamental studies of Burton, Burton and Martin, Winslow, Herrington and Gagge, DuBois and Hardy, Hardy, DuBois and Sodestrom have developed methods for the measurements of heat loss and peripheral blood flow. Based on these studies, Keeton and associates studied the transfer of heat from the interior of the body and its disposal in normal subjects submitted to environments with varying dry and wet-bulb temperatures. A summary of these adjustments is shown in Table 1. The heat produced in the interior of the body will be convected to the surface by the flow of blood through it and will be conducted through the surface at a rate determined by the temperature gradient.

The adjustments that facilitate the heat disposal as the surrounding environment is changed from a comfortable to a hot, moist one may be enumerated:

(1) The peripheral blood flow expressed in liters per square meter per hour may be increased up to seven times. The extra blood to fill the surface areas is obtained largely by shunting it from the viscera. The blood volume may be augmented from the reserve depots by as much as 10 percent.

(2) The cardiac output in liters per hour will be increased 50 to 60 percent.

(3) The heart rate will be increased.

(4) When these adjustments fail to eliminate the heat produced, it is stored and the rectal temperature rises. Storage of heat represents a physiologic derangement which if allowed to go uncorrected will terminate in heat stroke and death.

(5) When heat is stored, the oxygen consumption rises.

The net result of these adjustments is the development of a stress which throws more work on the cardiovascular system.

If the patient should develop hyperthyroidism with an increased heat production of 75 to 100 percent, and if he should be exposed to the hot, moist environment of the summer months, which retards the heat disposal, then the heat which cannot be eliminated is stored. The patients pass rapidly into a hyperthyroid crisis, a complicated clinical emergency.

Stewart and Evans have reported that the peripheral blood flow in patients with hyperthyroidism was increased and bore a linear relationship to the increased heat production. The cardiac output also was increased, but the peripheral resistance was lowered. These adjustments facilitated the blood flow through the periphery. Measures which reduced the heat production lowered the peripheral blood flow, cardiac output and increased the peripheral resistance. The physiologic responses of the hyperthyroid patient in eliminating the extra heat were similar to those of a normal subject who was having difficulty in eliminating his normal quantity of heat because of a hot, moist environment.

It has long been recognized that cardiac deterioration commonly occurs in patients with hyperthyroidism, but it is only since the magnitude of the work required of the heart by hyperthyroidism has been appreciated that this deterioration has been attributed to overwork. With a doubling of the heat production and an exposure of the subject to hot, moist environment, approximately 35 percent of the cardiac output is required for the disposal of the heat. A cool, dry environment is an important therapeutic agent for such patients. It is generally recognized that patients with heart disease tolerate hot, moist weather poorly. A hot wave may be followed by a wave of cardiac deaths. These patients who are living a precarious existence with little or no cardiac reserve succumb to the extra work

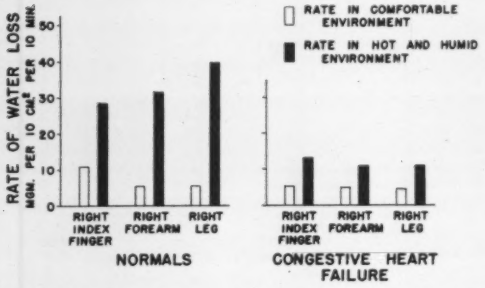

Fig. 1—The rate of water loss in normals and patients with congestive heart failure

(Adapted from studies by Burch, American Journal of Medical Sciences 211:181, 1946)

of eliminating heat against an unfavorable environment.

Cohn and Steele reviewed the records of 368 cardiac patients and noted that when unexplained fever existed in many of these, an improvement in the circulation led to a dramatic fall in the fever. It was noted that the surface temperature of cardiac patients was lower than that of normal subjects, and the rectal temperature was higher than that of normal subjects. This elevation of rectal temperature was interpreted as evidence of heat retention. This theory was submitted to the experimental test of inducing a mild obstruction of the blood flow to the extremities. A rise in rectal temperature was promptly noted. It is a common observation that when the circulation is stopped by death, the post mortem temperature of the interior rises to great heights.

Burch has observed the rate of water loss from the right index finger, right forearm and right leg in normal subjects and in patients with congestive heart failure in comfortable and in hot and humid environments. The results are shown in Fig. 1. The normal subjects increase their water loss from three to seven times when exposed to the hot conditions. The patients with congestive failure had a smaller water loss in comfortable environments than the normal subjects. In hot and humid environments the water loss from patients with congestive failure was one-half to one-third of the amount lost by normal subjects. The more severe the failure, the smaller the amount of water lost under both conditions. This decrease in water loss is due to a reduction in peripheral blood flow, which in turn is attributable to slowing of the blood flow through the capillaries rather than to a reduction in their size. A reduction in circulation time is a well-accepted finding in congestive failure.

It is well known that a dog is able to supplement his peripheral heat loss by increased water loss from the respiratory tract through panting. The relative humidity of the expired air of normal subjects and patients with congestive heart disease is 88 percent, the increased pulmonary ventilation of patients with congestive failure over normal subjects amounted to 25 percent, but the total extra heat loss from the respiratory tract by cardiac patients in a comfortable environment was only nine percent above that of the normal subjects. This increase was due to the greater evaporative and convective losses. It should be clear that this pulmonary gain in heat loss which has been demonstrated for a comfortable environment would be largely lost in an environment with elevated dry and wet-bulb temperatures.

Table 1—Circulatory Adjustments to Hot Environments

CONDITION OF ENVIRONMENT		HEAT PRODUCTION	HEAT DISPOSAL			BLOOD FLOW	CARDIAC OUTPUT	PERCENT CARDIAC OUTPUT FOR HEAT LOSS PER M²	RECTAL TEMP.	PULSE RATE
D.B.T.	W.B.T.		STORAGE	CONDUCTION	CONVECTION					
°F.	°F.	CAL./M²/HR	CAL./M²/HR			LITERS PER HR. PER M²	LITERS PER HR.	% / M²	°F.	BEATS PER MIN.
COMFORT										
84.0	64.6	36.3	0	24.5	11.8	4.2	144	2.9	97.5	63
HOT DRY										
99.5	71.6	36.7	1.6	10.4	24.7	20.2	174	11.7	98.4	68
HOT WET										
99.5	90.0	42.9	7.7	7.2	28.0	33.8	243	13.9	99.5	87

The cardiac patient with congestive heat failure is at the mercy of the weather. This explains the observed correlation between the rise in cardiac deaths with a wave of hot and humid weather.

Potts, who has submitted to operation a large number of children with congenital anomalies of the heart, has reported that fever occurs in a large number of the cases, especially those with cyanosis. Many of the children reach the hospital in a critical condition and in need of immediate surgery in order to increase the blood flow through the lungs. Experience has shown that the elevated temperature gave a bad prognosis. More recently this emergency has been met by placing the child on a refrigerated mattress and proceeding with the operation. The rectal temperature is lowered to 92 deg F. The heart rate slows and the child can then be anesthetized with a much smaller amount of the anesthetic agent. The value of this procedure has been reflected in lower mortality statistics.

We have already reported that well-compensated heart cases stood the exposure to hot, moist conditions without signs of embarrassment. In these patients the only work performed was the standard Masters step-up test. As the result of Potts' observations, Dr. Hick has exposed a patient with congenital heart disease and cyanosis to a hot and humid environment with alarming manifestations.

Burch also has pointed out the great distress produced in patients with congestive heart failure on exposure to hot and humid conditions. He describes the symptoms as those of acute pulmonary edema, which indicates the onset of a grave, clinical state.

During the summer months of the last year, we have received an increasing number of requests from the chest surgeons for the post-operative housing in air-conditioned spaces of patients from whom a lobe of one lung or the entire lung has been removed. It is quite easy to understand that such operative procedures may throw upon the peripheral surfaces the complete load of heat elimination, due to respiratory embarrassment resulting from the pneumothorax or accumulation of pleural fluid.

This portion of the discussion may be summarized by saying that air conditioning is indicated in the handling of patients under the following conditions:

(a) Whenever the environment makes the adequate elimination of heat difficult or impossible.

(b) Whenever the cardiovascular system is unable to adequately transport the heat to the surface of the body.

(c) Whenever the nervous control of the cardiovascular system has been deranged by anesthetics or by immaturity.

In practice, the following areas of the hospital have been designated for air conditioning:

(1) Pediatric ward and nursery. These patients lack adequate control of the heat-

regulating mechanism because of immaturity.

(2) Operating rooms. These have been air-conditioned largely for the comfort and effectiveness of the surgeon and for the prevention of anesthetic accidents. It should be pointed out that an anesthetized patient loses control over his heat-regulating mechanism and is for this reason subject to heat stroke in the summertime in hot, humid environments.

(3) Recovery wards. A recovery ward is one to which the patient is returned for 48 hr or more postoperatively. The purpose of such wards is to have critically ill patients under constant supervision. Private hospitals have been slow to adopt such wards, largely because of the demands of the individual and family for privacy. If this type of ward were adopted and air-conditioned along with an air-conditioned operating room, heat strokes would be eliminated. At present there is far too little knowledge of the post-operative retention of heat disseminated among apparently competent surgeons. Such a ward would be an excellent one for patients with chest operations.

(4) General medical ward. The need for air conditioning of a general medical ward has not been recognized up to the present time. There is agreement that patients with asthma or hay fever due to inhalants are benefited by filtration and conditioning the air.

I hope I have made clear the importance of air conditioning for cardiac patients. They constitute a large part of the medical hospital population. Senile patients who may be classified as a subdivision of cardiac patients require it. In fact, almost any debilitated patient will find such an environment helpful.

Fields for Investigation: Doctors are constantly advising patients who have a chronic illness to change climates, but they have no accurate information on which to base such advice. This advice is commonly given to patients suffering from respiratory diseases. Some of these patients require an atmosphere with high humidity and others one with low humidity. Time does not permit an elaboration of this subject.

There remains for consideration the disturbing effect of climatic changes on human subjects who are undergoing long-time clinical investigative studies. Experimental animals are kept on rigidly-controlled environmental conditions when they are being used for experimental purposes. The same could be done for the human subjects.

Problems Following Atomic Blasts

By Oscar Schneider

CAPT. OSCAR SCHNEIDER (MC) USN, Washington, D. C.—A native of San Francisco, he was raised in Portland, Ore. He was graduated from the University of Oregon Medical School in 1931, and has been in the Navy Medical Corps since that time. During World War II he served aboard aircraft carriers in the Atlantic and Pacific. Following his participation in Operation Crossroads in Bikini, he was connected for several years with atomic defense matters in the Navy Department. At present he is assigned to the Reactor Development Division of the Atomic Energy Commission.

The first four speakers having shown how we strive to improve things and build them up, it would almost seem that I am left with a job of tearing things down. But on the contrary, I hope to show that so far as the possibilities of atomic war are concerned, its defensive aspects are not nearly so hopeless as some may think.

The effect of atomic blasts is a big and wide subject to try to cover in a few minutes' time. There has been a great deal written and said about it and no doubt many of you have read publications, both official government pamphlets and privately issued publications, the purpose of which is to explain to the individual what he may do to protect himself against the effects of an atomic bomb.

Perhaps for some there may have been too much of this literature. I wonder if you recall the cartoon which appeared in the newspapers a few months ago? It shows a man sprawled out in a chair crosswise, in complete exhaustion. He has a book on What to Do, etc., over his face, and scattered around him are other piles of books on Atomic and Civil Defense. His wife is remarking to a caller, "Otis has just about given up on trying to save his life in case of an A-bomb attack . . . . says it's too much trouble. . ."

That may be the way some of us get to feel after reading a lot of this material. So what I propose to do here is to present a simplified discussion, perhaps one or two things which may be of help in understanding the whole problem.

Fortunately, in preparing a simplified discussion of this kind we have a number of excellent technical papers to draw upon, notably the book, *The Effects of Atomic Weapons*, which was prepared by a group of military and civilian experts working under the general direction of the *Los Alamos Scientific Laboratory*. The technical data upon which this discussion is based are taken from the *Effects of Atomic Weapons* or other similarly authoritative reports, and the recommendations of what should be done immediately following an atomic explosion are from reports of the *Federal Civil Defense Administration* or other competent civil defense authority.

It is clear to anyone who has read the *Effects of Atomic Weapons*, or other authoritative publications, that the number of casualties as well as the amount of physical damage is more nearly proportional to the blast effects of the bomb, than to any other effect. We are speaking, of course, of a bomb exploded high in the air, such as the bombs used against Hiroshima and Nagasaki. After the Japanese blasts, there was an area roughly a half-mile radius below the burst of virtually complete mechanical destruction and from 90 to 100 percent fatalities. Outward from this area to a distance of two miles from the center, the damage ranged from heavy to light, while the casualty effects varied from severe to mild. Beyond two miles the damage was confined largely to broken windows and falling plaster, and accordingly, injuries to people consisted largely of minor lacerations and contusions. No effects whatever occurred beyond eight miles.

Of course, there will be a large number of burn cases of all degrees of severity after an atomic explosion. These cases will be of the flash burn type, which occurs from exposure to the light and heat produced by the bomb, and of the flame type caused by being trapped in burning buildings and houses. These burn injuries will be seen mainly in the area of severe and moderate blast damage, since this is the area in which the most fires will occur.

The radioactivity of an atomic explosion has perhaps received more publicity than any of the other effects. It must be made clear that radioactivity alone will account for probably not more than 15 or 20 percent of the fatal injuries. Of course, when we consider that a single atomic burst may produce as many as 60 or 70,000 fatal injuries of all kinds in an unprotected and an unalerted city, this percentage of radiation cases may amount to a rather large number. On the other hand, if we assume that a city has brought its civil defense arrangements to a maximum efficiency, and that there has been time to alert the populace, it has been estimated that the total number of dead, including radiation victims, may be only one-half as great, or less.

Please do not misunderstand. This is not an attempt to minimize the atomic bomb as a potent means of mass destruction. Indeed, an atomic attack could not be compared in magnitude to any single disaster which has ever occurred in our country. We may form a mental picture of the effects of a Hiroshima-type atomic explosion over a populous city as follows: take one San Francisco earthquake, add ten Pearl Harbor disasters, ten Texas City explosions and fifty Cocoanut Grove fires: combine with 10,000 or more killed or injured by radiation. The result will be a catastrophe which approximates the effect of a single atomic bomb explosion over an unalerted and unprepared city.

There are, as we know, other types of explosions which may be produced by the atomic bomb, for example, the surface type and the shallow underwater type of bursts.

Again, it may be predicted that the casualty rate from these explosions would be related to the blast effects. The blast damage from these types of bursts is less extensive than in the case of a high air burst; therefore, there will be few casualties. When an explosion is produced on the ground surface or under water, there is a tendency for fission products and other sources of radioactivity from the bomb to be deposited over the affected area, and to cause lingering radiation. This would be expected to produce a rather higher percentage of radiation victims than in the case of an air burst.

In a high air burst, fission products are not deposited on the ground in sufficient concentration to produce a hazard; it is only in the first few moments after the explosion that most of the radiation effects take place.

Space does not permit even a bare mention of the steps which civil defense authorities have recommended for community adoption in order to properly prepare a community against an atomic explosion. As stated previously, this has already been done many times. Certain special phases of the subject might be of interest to the reader. In the first place, there is the matter of shelters. The construction of bomb-proof shelters for an entire population is considered by defense authorities to be impracticable within an area which is likely to be in close range to an atomic explosion, except perhaps for the protection of key installations, for example, control centers, and communications or rescue facilities. However, it has been pointed out that cellars and basements, as well as subways, bank vaults, and other subterranean structures would provide means of shelter for those in their immediate vicinity. Those who are so unfortunate as to be caught in the open within a range of from half to one mile of an explosion would have a very poor chance of survival. If they are sufficiently gifted with presence of mind, and can dodge behind a substantial building or in a doorway upon seeing the flash, it is possible that they might escape fatal injury from flying or falling missiles and from the heat and radiation of the bomb. But even if the most heavily reinforced shelters existed in sufficient numbers throughout a central area there would obviously not be time for the majority of people to make use of them unless there was a sufficiently long warning period.

It is again emphasized that the radiation aspects of the bomb are comparatively minor, and we must not get into the habit of exaggerating this feature, but the radiation effect is a new effect in warfare, and is perhaps on that account subject to an interest and curiosity out of proportion to its importance.

We have read about the *fall-out* of radioactive particles from an atomic cloud — how, if meteorological conditions are right, these particles may settle over a considerable area and produce contamination of streams and watersheds and food supplies, and even animals and human beings. As a matter of fact, such contamination is known to have occurred, but to a negligible degree.

In the case of a surface explosion such as might occur if a bomb fails to explode at a high altitude, or as a means of sabotage, there would be an area, mostly confined to the crater produced by the bomb explosion, which would be at first dangerously contaminated. But after a matter of hours or at the most, a day or two, it would be possible for personnel to enter the area using ordinary protective clothing and gas masks. In the event of an underwater burst, there would be a contaminated area which might remain dangerous for a somewhat longer period, but there again, under emergency conditions it would be possible to re-enter such an area after the first day or two for a period of time depending upon the degree of radioactive contamination. In any case, it is hardly likely that rescue and salvage operations, carried on by properly equipped teams, would be seriously hindered by radiation hazards alone.

Radiation should be respected and guarded against but not feared. Accordingly it would be well for everyone to have some basic knowledge of the effects of radiation and thus be in a position to understand this threat, and not be unduly afraid of it. It is known that an atomic explosion will give rise to various types of penetrating radiations, namely, gamma rays, which are electro-magnetic rays similar to x-rays; neutrons, which are electrically neutral particles thrown out of atomic nuclei; and also, alpha and beta rays which are nuclear particles of positive and negative charges, respectively. The alpha and beta particles are readily absorbed in the air, and are not a hazard in an air burst.

The neutrons have a range of only about 2,000 to 3,000 feet in air. While they are difficult to protect against, this range is well within the area of maximum destructiveness of the other bomb effects, and therefore, the neutrons do not really constitute an additional hazard.

The gamma rays are then the chief source of trouble from a high air explosion. They will reach out in lethal intensities to a distance of about 4,000 feet after which they fall off very rapidly.

When a living organism is subjected to gamma rays or any other penetrating radiations the result in the body of the organism is due to ionization which these rays produce within its cells. The amount of this ionization cannot be measured by any known means but it will cause sufficient chemical disruption of the cellular contents to produce disastrous results, both directly within the cell and indirectly to the entire body as a result of injuries to these cells.

Cells of the human body which are most readily affected are the blood-forming cells, after which next in susceptibility are the cells of the lining of the intestinal tract, and other tissues. It is thus fairly easy to understand the general picture of radiation illness. Injury to the intestinal tract and to the elements of the blood which produce clotting results in severe intestinal bleeding. Injury to the blood-forming tissues produces a condition of almost complete lack of the white blood cells, which are one of the chief forces of the body to withstand infections. Injury to the tissues which produce red cells further complicates the picture by producing oxygen lack and other effects of anemia in the body. The severity of the illness depends on the amount of radiation received. Injuries to the blood-forming structure and other tissues are not necessarily permanent, so that when the amount of irradiation is less than fatal, these tissues will recover, especially if the body is aided in its recovery process by proper medical therapy which includes complete rest, adequate intake of nutrients and fluids, including blood tranfusions, and use of aureomycin or similar disease-fighting drugs.

Those who have been overwhelmingly subjected to total body irradiation will go into shock almost immediately, and be dead within 24 to 48 hours. Those who have received a lesser, but still a fatal amount may live for one or two weeks. Those who have received a heavy but non-fatal dose but are weakened by other injuries and perhaps by severe chronic diseases, such as tuberculosis, may succumb from these multiple causes. Of those who receive less than a fatal amount, and who are otherwise essentially uninjured, the effect in their case may be hardly noticeable after the first day or two of nausea and weakness.

There has been some concern over the genetic and hereditary effects of radiation. Actually, there is not too much evidence to go on. Experimentation with flies, other lower animals, and plants shows that changes in the heredity of these organisms are produced by x-ray or other forms of radiation, and even by certain chemicals. In most cases the effects of such mutations are lethal so that the offspring dies during development. There is a natural rate of occurrence of mutations and radiation tends to increase the rate. But there is no positive evidence that radiation-induced mutations are different from these which occur naturally. So far as sterility is concerned, most of the survivors in the Japanese cities who have been examined have been found to be fertile, and their children in all cases, so far as we know, show no traces that their parents had ever been subjected to radiation. If there is any noticeable hereditary effect, its results may not be seen for many generations.

Among the more striking effects seen in connection with the bombing of Hiroshima were the psychological effects. Observers have stated that a large number of the survivors wandered in a daze for hours after the blast, seemingly unable to com-

prehend what had taken place. This mental dis-orientation may have been the result not only of the magnitude of the blast, but also of its shocking effects on their city, their homes and their families. Other Japanese cities were accustomed to air raids, but Hiroshima had not previously been attacked. When the city was destroyed by one gigantic blast it proved psychologically too much for many of its surviving citizens. A great number of them ran away in a panic. Thousands of those who died might have been saved had they not for this reason been left to perish in the flames. The terror-producing effect of the bomb is among its most threatening possibilities.

It is desirable to provide a brief summary as to what civil defense authorities have recommended for an individual to do to protect himself and his family in the event of an A-bomb attack.

First of all, they recommend, each person should thoroughly familiarize himself with all instructions which have been provided for his protection by his local *Civil Defense Organization*, and in the event of an emergency should be guided by these principles.

The basic maneuver for any person to adopt at the instant of seeing the flash of a bomb, civil defense officials say, should be to take shelter immediately as best he can, behind the corner of a heavy building, in a doorway, ditch, or even gutter, dropping flat, face down, and covering his head in his arms. He should remain in this position for a few seconds until flying objects have ceased to fall. If uninjured he may then arise and try to help others who have been hurt, using proper methods of first aid.

If police, firemen, or air raid wardens are present, he should be guided by their instructions. The individual must make every effort to keep calm. Under no condition should he rush about aimlessly, or say anything to add to the confusion. To do so might cause a panic which could cost his and others' lives. Those indoors should avoid the windows and crouch behind a desk, counter, safe, or other sturdy object. Those in an automobile should pull over toward the curb and get out of their cars at the first warning to avoid injury from shattered glass.

In the summertime, people should wear loose clothing of a light color which covers as much of the body as possible, in order to minimize flash burns. A hat with a brim should be worn outdoors.

In the home, a shelter should be arranged in the basement or cellar, equipped with emergency food and medical supplies, flash lights, cots and blankets. The shelter should have at least two means of exit.

During an alert, members of the household should immediately proceed to the shelter and remain there until the all-clear is sounded unless the house is afire. The master switch should be opened, and the gas turned off throughout the house, preferably at the meter. The flames of hot water heaters and oil burners, and all other fires should be extinguished. If there is a washing machine or laundry tub in the basement, this should be filled with water and covered, to provide an emergency supply in event of damage to the water mains. The water supply should then be shut off.

The entire house should be cleared of all accumulations of waste paper and other unneeded combustible materials. Only minimum quantities of gasoline, cleaning fluids, and other inflammables should be stored.

If there has been no prior alert, people in the house should go to an interior hallway or else take shelter under a bed or heavy table, immediately upon seeing the flash of the explosion, avoiding the windows. After a few seconds, when the initial blast effects are over, they should get up and examine the house for fires which should be extinguished at once, using sand, wet blankets, or any other available means.

The householder also should cooperate with the air raid warden in his block, and comply with all instructions of the Civil Defense authorities.

Those who desire additional detailed information may consult *The Effects of Atomic Weapons*, previously mentioned, *U. S. Civil Defense*, prepared by the *National Security Resources Board;* and *Survival Under Atomic Attack*, prepared by the *Civil Defense Office* of the *National Security Resources Board*, now called the *Federal Civil Defense Administration*. All of these and other publications on civil and atomic defense are available from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Discussions

W. L. Fleisher, New York, N. Y.: There is only one reason why I want to be the first to talk on this subject, following the discussion of the panel, and that is because I have been associated with this particular subject longer than anyone else in the Society. I have been connected with it both through papers, through the laboratory as a member of the Committee on Research, and later as Chairman of the Committee on Research, as Chairman of the Committee on Comfort Air Conditioning and Chairman of the Committee on Air Conditioning in Industry for a total of some 27 years.

I have right along criticized your approach to the subject because I do not believe that it takes into consideration the fundamental reactions and causes of the reactions of man to his environment. One of the interesting things that has been brought out this morning is in connection with the point in the so-called comfort zone where most people are comfortable. However, of much more importance fundamentally, the research and investigations that have been made would indicate that there is a definite point where nobody is comfortable. As I remember, this point or zone is approximately at 79 ET (effective temperature). Why this is so nobody has pointed out. It is very important from the point of survival whether this does not correspond to some particular equilibrium basis that is fundamental to our origin. I have suggested to the Society for many years that investigation be built around this particular coincidence.

There are other points of fundamental importance which I feel should be investigated but which have not been brought out this morning.

D. H. K. Lee, Baltimore, Md.: I presume that one of the purposes behind this symposium, as enunciated by Prof. Hatch, is to point out those fields in which research is still badly needed. I will, therefore, mention some things that occur to me.

First of all, only passing reference has been made to our own problem of dryness of air. My colleagues in the Department of Environmental Medicine at *Johns-Hopkins* tell me that one of the most important factors affecting the physiology of the respiratory tract is the dryness of air; that when the air is dry, the motility of the little hair-like cilia, which presumably are important in defense, practically ceases. They are now engaged in setting up some environmental studies to test this out with the cold virus which they believe they have now under control in the laboratory. I think the Society could well sponsor further inquiries along those lines.

Secondly, I agree very much with Prof. Hatch that we badly need to study and set up guides for that intermediate zone between what is comfortable and what is merely tolerable, but I would emphasize that they are only going to be guides. I don't think we can ever have a cut-and-dried answer and just pick the thing off a chart and say, "There it is, that is what you must have." I wouldn't like to be the man who tried to put it over, anyway.

In these studies I think the Society could go a little bit beyond the structure of the building and the air conditioning and take into account something else which is available, although it is not primarily their responsibility, and that is the clothing of the worker.

There are many industries in which clothing has to be adjusted to other facets of a job; and I don't see why at the same time the environmental conditions should not be taken into account. There are many industries in which that is an important factor.

I thoroughly agree that a study of the long-term reactions of men to environmental conditions is badly desired. There is no such study going on, to my knowledge. It has frequently been suggested, but nobody has ever started it.

These and many other fields of research required are going to take time, they are going to take patience and they are going to take money.

A little while back I came across some figures of the amount of funds available for research by the Society and directly under the control of the Society, and I was astonished at the figures. I cannot believe that those figures tell the whole story. I hope they do not, because they were just a mere drop in the bucket.

I do think that some responsible body in the Society could very well take up on an intensive basis the study of the financing of really worthwhile, long-term projects, but I can assure every member present that one of the items in such a plan would be a drain on their own pocketbooks.

L. E. SEELEY, Durham, N. H.: In 1940 I presented to the Society some studies of the change in temperature and moisture content of respired air, and changes in the nasal cavity. They were very extensive, covering a wide range of environmental conditions.

It was my impression from the work that it was possible for the human body, and the nasal cavity in particular, to become adjusted to, and in a state of equilibrium with, the particular air conditions involved, *i.e.*, high temperature, low temperature, high or low humidity, and that equilibrium could be established over a wide range.

The thing that interested me — though I talk as a layman now, not as a physiologist — in respect to respiratory infection, which Dr. Keeton touched upon, was not the fact that your equilibrium could be established, but that the adjustment from one environment to another will take an appreciable time.

For example, if one were to be outdoors at fairly low temperature, possibly at high humidity, moisture losses would be relatively low from the nasal cavity. Upon entering a room such as this one, with fairly high temperature and low humidity, there would be an instantaneous change in rates of moisture loss from the nasal cavity and there would be some appreciable lag before a new equilibrium was established.

It has just been my belief that during that brief period the possibility of an infection is particularly high. I think it is true that the normal mucosa covering the turbinates in the nasal cavity are quite protected and somewhat germicidal in character, so that if your nasal cavity is in normal condition you have a fair amount of protection, but if a sudden change takes place it may be possible that the so-called normal condition does not exist for a brief period. Whether it is a minute or two minutes or three minutes, I have never determined, but I think it is the rapidity of change that must be considered.

One other comment only, and that was in connection with a slide shown by Dr. Keeton where he showed you a very large moisture loss from the lungs. This work to which I referred indicated that very little of that moisture comes from the lungs; that most of the air conditioning, as it were, is done right in the nasal cavity itself. It is a very remarkable device, gentlemen. We haven't quite equalled it mechanically.

W. A. GRANT, Syracuse, N. Y.: I rather imagine that the greatest number of people here are engineers and members of the Society and the second greatest number are probably representatives of the medical profession, that being so because of the nature of this symposium. I would like to throw out a rather practical question.

This whole business of relating the environmental properties of air has been knit together in the form of effective temperature index many years ago, and all of the studies which have succeeded have used this index as a good criterion for relating properties. Yet I find in my own profession that the index just has not become a useful day-to-day concept of one's thinking. I suspect the same is probably true in the medical and other scientific professions.

I would like to throw out the general question — and I hope some of the members of our panel up here will comment also: Is the effective temperature index a thing which you think about and use in your day-to-day work? Can it be improved? Should it be better publicized in the public mind with relation to air conditioning, or should we allow it to fall into desuetude? I would like to hear some discussion on that.

MR. LEOPOLD: I believe that we use the effective temperature concept without thinking of it specifically as effective temperature. One thing which has apparently delayed the concept's use in our casual thinking and the use of the concept by other professions, such as the medical profession, is the fact that the line is named for the dry-bulb temperature at saturation. If we say 71 *effective temperature* we do not have a clear mental picture because we do not customarily think in terms of saturation, in comfort.

In 1937 J. R. Parsons proposed that we name the lines by the dry-bulb temperature at 50 percent relative humidity. In other words, the 71 *ET* line would become the 76 *ET* line. Knowing that it indicated the dry-bulb temperature at 50 percent relative humidity, a condition with which we are familiar, it would be very simple mental arithmetic to adjust for humidities of 20 percent above or below. Mr. Parsons' suggestion was originally not well received, but in yesterday's meeting of the Committee on Sensations of Comfort there was considerable discussion as to whether or not his suggestion should be adopted. Against the change is the fact that there is a very extensive literature which uses the present system. In favor there is the fact that the longer we delay the greater would be the complication.

W. F. WELLS, Philadelphia, Pa.: May I add a word to Dr. Keeton's remarks on airborne infection? Though recently health authorities have rebuked certain advertisers of glycol dispensing devices, never has the profession been more solidly behind constructive development of the art of sanitary ventilation. The last report of the Sub-committee on Air Sanitation of the *American Public Health Association* formally recognizes the importance of sanitary ventilation in public health and favorably reviews a mass of evidence reported during the last three years.

Today no informed person doubts that hospital air is infectious; air sanitation has reduced infection of surgical wounds and has protected burns against streptococcal infection during dressing; Blackfan and Yaglou reduced mortality among admissions of premature infants (diagnosed as acute or chronic infections) from 27 to 3 percent by air conditioning a separate ward; many hospital studies report reduction of cross-infection when the air of wards was disinfected.

Now that we have learned how to disinfect hospital air, we find that the problem of control of respiratory infections outside the hospital is *where* to disinfect air. When respiratory epidemics breed indoors, everyone is exposed to airborne contagion in various atmospheres. To check the breeding of these epidemics, the sanitarian must locate the communication centers, and the engineer provide threshold sanitary ventilation. This Society can do its bit by releasing for publication in the ASHVE JOURNAL the Report on Definitions, Formulations and Factors, submitted well over a year ago by the Technical Advisory Committee on Air Sterilization.

MR. LEOPOLD: In 1932 Drs. Lagen and Kerr, of the *University of California* Medical School, San Francisco, conducted some experiments in which they tried to transmit the common cold in an air conditioned room maintained at a condition of approximately 70 F and 55 percent relative humidity. The subjects occupied this space continuously, in contra-distinction to the occupancy we have largely discussed here, where the subject is in the air conditioned space for the work week — approximately 25 percent of the total. In these experiments it was found impossible to transmit the cold in spite of the actual transfer of the exudate from the nasal passages of one individual to the nasal passages of another. I am referring to these experiments in order to call attention to the danger of generalizing as to the expected effects of a continuous exposure and a 25 percent exposure by time.

MR. WELLS: There is the question of susceptibility that enters into every discussion of infection.

MR. LEOPOLD: Susceptibility was carefully covered in the paper by Drs. Lagen and Kerr. All of the subjects were known to be sensitive to colds.

DR. KEETON: I would like to acknowledge the discussion by Mr. Wells, who is a pioneer in this field. Of course, we owe to him much of the information relative to the size of droplets. I think it is agreed and has been accepted that air conditioning is valuable in pediatric wards. I think that is pretty well es-

tablished. Of course, the child lives pretty continuously in there and that may be one way of isolating him more completely than we have in the adult.

It has also been shown in some experiments that ultra-violet radiation will sometimes protect children when they are presumably being handled by nurses who have colds. I don't know how far that can be tested. I think the difficulty that has arisen with this viewpoint is the fact that when you come to apply it to adults, large groups of men who are living perhaps for part of the day, or a good portion of the day in these quarters, and another portion out, it just hasn't worked out that we have the solution for the prevention of respiratory infections.

PRESIDENT AVERY: The subject is a fascinating one to me, Dr. Wells, and I am glad you brought it up because in talking to the heads of hospitals I find a complete indifference regarding the value of using our tools. When I say to a medical man, "We have these tools. What do you want?" he is likely to reply: "Well, I guess we have got to keep the window closed. We don't have the money to pay for refinements such as air cleaning."

Very few hospitals use even an elementary air-cleaning system.

We may not be able to prove the value of air conditioning on intermittent occupancy, but we could probably do so in the case of a penitentiary where men are confined continuously and for a long time.

P. B. GORDON, New York, N. Y.: My question is strictly a design question. I had hoped that Captain Schneider would touch on it when he was discussing the possibilities of ventilation of indoor protected shelters. Is there any justification, in view of your statement on blast effects and some of the statements that are made in the publication you refer to, known as *The Effect of Atomic Weapons*, for the so-called ultimate filters in the cleaning of air supplied to these protection shelters, or is there a lack of justification due to the short period of use and the possibility that other dangers may be introduced by the use of such filtration details in the design of such air systems?

CAPT. SCHNEIDER: It is not up to me to say whether we should or should not have shelters. However, if we do have shelters, they obviously have to be sufficiently well built to withstand not only heavy blast pressures, but also other bomb effects. The ventilation of shelters has been more or less thoroughly worked out in the last war. The new thing about the ventilation problem not only in shelters, but for that matter in buildings which are intended to be blast-resistant is the matter of radioactive contamination.

I feel, and I think with some backing from competent authorities, that if you are going to build a shelter it would have to be either properly ventilated to withstand the possible contamination effects, although, as I said before, in the case of an air burst there may not be any lingering contamination from the fission products of a bomb. Nevertheless, no one can tell whether the bomb will burst in the air, or on the ground, or under water, or where. So you have to have ventilation.

As I said, I am not a ventilating engineer, but you could have a self-enclosed ventilation system without having to worry about taking in outside air. You could also have a ventilation system which depends on intake of outside air with exhaust. In this case there would have to be filters, I believe, capable of removing such particles as are considered to be of significant size; and more than that, methods would have to be worked out for handling these filters once they became contaminated, and also for disposing of them.

W. C. L. HEMEON, Pittsburgh, Pa.: In Mr. Hatch's provocative discussion of the thermal range between comfort and extreme heat prostration in environmental conditions, he touched on the subject of radiation and your Moderator, interestingly enough, referred to this subject after Mr. Hatch had finished.

I would like to ask Mr. Hatch if he wouldn't like to comment a little more on that particular phase. He has conducted some very interesting industrial research on radiant heat exposures. The point I would like to see him emphasize is the fact, which I believe to be true, that the radiant factor in industrial heat exposures is far and away the most important single element.

I think perhaps, Mr. Hatch, the audience might be interested in your method of describing the units in which radiant heat exposures are described.

PROF. HATCH: We must differentiate between two kinds of hot industries. There is, on the one hand, the industry in which high air and radiant temperatures are the chief contributors to the heat load, and on the other, the industry in which high moisture content of the air, rather than temperature, is the characteristic factor.

In the hot dry industry, illustrated by steel mills, glass manufacturing plants, forges, and the like, outside air, with its moisture content, whatever that may be, is brought inside and heated up to the elevated temperature with a corresponding decrease in the relative humidity. In such industries there is not the danger of an acute heat problem in the sense of failure because of inability of the evaporative mechanism to operate, as may be the case in the warm, moist industry.

In these hot dry industries more detailed examination of the nature of the thermal load brings out the point that Mr. Hemeon mentioned. Our studies, specifically in glass plants, have demonstrated that two-thirds to three-quarters of the heat load imposed on the worker is in the form of radiant heat rather than convective heat. The standard procedure for heat control in those industries is by ventilation; but even with perfect ventilation it would not be possible to remove more than a quarter or a third of the total heat load. To attempt more than that through refrigeration would, of course, involve great expense.

On the other hand, it is possible to bring about some very spectacular improvement in the environment through direct radiation screening, and with relatively little expense.

There was earlier mention of the asymmetry of radiation load and its importance in the normal environment. It is even more striking in the industrial environment. In the analysis of the radiant heat load, therefore, it is not enough merely to measure the mean radiant temperature, as it is commonly known, with the globe thermometer. The distribution of the radiation must also be determined in order that radiation screens can be applied in those directions from which the greatest benefits will come.

Our experimental work has indicated the possibility of reducing the heat load as much as 68 percent through the application of radiation screens, their locations being dictated by an earlier study of the directional aspects of the radiation distribution.

I should like to suggest, in closing, that there are certain dangers in the use of the effective temperature, or any other single index which combines the several environmental factors. In the very act of bringing them all together and expressing them as a single figure, we may lose sight of the relative importance of the separate contributors to the total heat load. I believe this explains to a degree the amazing difficulty in getting the idea across that radiation is, in these cases, the overpowering single factor in the makeup of the total heat load, and consequently in the design of the effective control measures.

C. M. ASHLEY, Syracuse, N. Y.: From the standpoint of the mechanical engineer, the heat losses that would occur at low body and surrounding temperatures, when the evaporation rate is very low, would be expected on the basis of normal heat transfer to be largely correlated with dry-bulb temperatures.

At the other end of the scale, however, when the body was fully wet it would be expected that the correlation would be almost wholly with wet-bulb except for the effect of radiation on the body. This is a very marked deviation from what we now know as the comfort relationship.

I was therefore particularly interested in the results of tests reported last year by Prof. Glickman and his associates and have found that that is exactly what was indicated by the results of that paper. It is true that the clothing worn was comfortable and perhaps that has an effect in relation to normal feeling of normally clothed subjects, but I do believe in view of the startling results that are suggested by that paper, and also by the fact that it makes sense with respect to what one

would expect from the standpoint of heat transfer in correlation with the surface temperature of the body, that the whole problem of the effective temperature line needs to be completely re-examined.

One other point I wanted to suggest to Mr. Leopold is that perhaps the shielding from radiant heat Prof. Hatch spoke of might be a subject for radiant cooling panels.

MR. LEOPOLD: The new calorimeter room at the Laboratory is constructed so that each of the six room surfaces can be maintained at a different temperature, both in whole and for the walls in part. The walls are subdivided so that cold glass and cold wall temperature can be simulated. The room is additionally well adapted for the checking of panel heating and cooling.

Experimental work is contemplated on all of these problems.

I. S. DANE, Boston, Mass.: I would like to bring the discussion back to a consideration of comfort and temperature. I might ask to digress a moment from the effect of the air on the individual. That seems to be over-stressed here. I don't want to over-simplify these problems, because they are very great, but Mr. Leopold touched on the point in his illustration of the effect of surrounding conditions on the stenographer seated with her back to a cold window and subject to radiation from a cast-iron radiator, and convection draft from the floor and the doors. It seems that the problem of comfort in the home and comfort in the office can be attacked from simple mechanics. Mr. Leopold didn't touch on the relationship of the effect of the radiation and the effect of the convection. It seems as though that could be mechanically controlled.

President Avery showed us when visiting *M.I.T.* that the simple location of a thermostat in a room where it would affect the radiator on the opposite side of the room, would not control the comfort zone near a cold window less than six feet away from the window. I would like to hear Mr. Leopold and possibly Mr. Avery elaborate on that point.

The other has to do with radiation and colors, perhaps the psychological effect of the colors on the individual. I think there is a lot of explanation that we could hear from these several men on that point.

MR. LEOPOLD: The ideal way to compensate for the cold glass would be to simulate a condition in which it didn't exist, namely, to have a source of warm or high temperature radiation paralleling it or actually interlacing it. This is a practical possibility, though an expensive one.

The next best thing that we can do is to install a warm radiant source below the cold glass or, alternatively, beside or above, with the objective of getting the warm source as near on the line of axis between the cold source and the person as is feasible.

In my paper Monday, I discussed the use of warm flat panels below the window glass. The purpose of the flat panel was to reduce the convective and accentuate the radiation effect. We have controlled such panels by sensing the glass temperature. Final control of air temperature is left to the air system.

G. LORNE WIGGS, Montreal, Quebec: It is apparent to me that the reasoning of the speakers, as is the thought behind most of the information on this subject given in the publications of the Society and in the writings of most of its members, is based on the assumption that human comfort or discomfort in an enclosure is maintained, among other things, by convection heating or cooling.

For instance, the ASHVE Comfort Chart and the Effective Temperature Index completely disregard any possible effect of variations in the mean radiant temperature of the enclosure. Yet radiant heating is rapidly becoming so commonplace on this continent (and radiant cooling gradually being adopted) that the effects of variations in mean radiant temperature should not be disregarded any longer in THE GUIDE and in the research work of the Society.

Dr. DuBois indicated roughly, I believe, the probable comfort zone for man on the effective temperature scale. Mr. Leopold stated that from his experience, optimum comfort existed between 74 F and 76 F and that this comfort condition was the same for both summer and winter, and not different for these two seasons as indicated by the ASHVE Comfort Chart.

Our experience in Canada with a large number of convection heating systems has convinced me that such temperatures as Mr. Leopold mentioned are unreasonably high in winter, at least for Canadians. Also, from extensive experience with ceiling type radiant heating, I am positive that with such systems as we design, a dry bulb temperature of 75 F would be rather uncomfortably warm for the occupants. It may be interesting to know that in Canada where with convection heating systems dry bulb temperatures are usually maintained at 70 to 72 F, with ceiling type radiant heating systems we have found the dry bulb temperatures being maintained between 66 and 69 F with a probable mean of 67½ F.

From the above it is obvious that the ASHVE Comfort Chart and the Effective Temperature Index cannot be used for buildings heated by radiant heating systems. A number of authorities have attempted to produce either equations, indices or comfort charts which take into account the mean radiant temperature of the enclosure. Professor F. W. Hutchinson gives a formula which is based on dry bulb air temperature and mean radiant temperature only. Winslow, Gagge and Herrington did, I believe, conceive the *Operative Temperature* index which takes into consideration mean radiant temperature, air temperature and air velocity but neglects any effect of relative humidity. This, like the others, cannot therefore be used in all the conditions of heating, cooling and air conditioning encountered in practice.

In trying to find a suitable comfort chart which would be thus applicable, I went to the writings of the physiologists of England, — the country in which modern radiant heating was conceived and in which it has now been used for over 40 years. I found that Dr. Thomas Bedford, of the *Medical Research Council* of England, has published a number of these charts. They all use a concept or index of warmth known as the *Equivalent Temperature*. Equivalent temperature has been used in England now for over 15 years with some slight modifications and it is a scale of warmth which takes into account air temperature, air velocity and radiation from or to the surroundings. One of these charts is an alignment chart by which equivalent warmth or comfort may be obtained from readings of dry bulb and wet bulb air temperature, mean radiant temperature and air velocity. This chart, which may or may not be strictly accurate in this climate is, I think, the type of chart which should be adopted for heating and air conditioning engineers.

As far back as 1936 Dr. Bedford made an investigation of the reliability of various scales of comfort in relation to environmental conditions, including the effective temperature scale, the dry kata thermometer cooling power and the globe thermometer temperatures. He reported making over 3000 sets of observations with nearly 2000 different subjects doing light work. From this he concluded that "up to a temperature of about 75 F the equivalent temperature scale is best of the measures of warmth included in the comparison." "It can be used", he stated, "in calm atmospheres or where there is much air movement, and it gives full weight to the effects of radiant heat. It is true that the scale makes no allowance for the effects of atmospheric moisture, but until the temperature approaches 75 F humidity exerts no great influence on warmth sensations." Furthermore, he added that "the reading of the globe thermometer is a good index of warmth where there is no great amount of air movement, as in the average workroom or office, since it makes adequate allowance for both air temperature and radiant heat."

I would like very much to receive Dr. DuBois' comments regarding the above and I would like to know if he has checked regarding the concept of equivalent temperature and what he thinks of the charts of Dr. Bedford. I would also like to know whether he, or any other members of the panel have used the globe thermometer in any of their work, and if so, what did they think of its value in determining comfort under the heating and cooling conditions usually encountered on this continent. Finally, I would like to know if any authority here has developed a standard globe thermometer.

Transportation Heating and Air Conditioning Systems and Controls

By Norman O. Kirkby*, Chicago, Ill.

SUMMARY—Heating, ventilating and air conditioning have become necessary basic requirements throughout the transportation industry. In recent years heating and air conditioning have been taken for granted by all those who travel, an indication of the forward thinking and progressive actions of the engineers in the transportation industry as well as the supply industries who meet the specifications as laid down by these engineers.

Little has been written or reported on the problems which face the industry, or the special equipment which is used in the fields of heating, ventilating and air conditioning.

This paper offers an insight into the specific problems and their solutions.

According to the present trend the American railroads are soon to be powered by locomotives other than steam. Therefore, the production of steam on diesel and electric locomotives must be substituted for the steam locomotive boiler as a source of heat, or heat generating equipment must be used on individual railroad cars. In addition, the distribution and control of the heating and cooling of railroad cars represents some of the most perplexing problems in the heating, ventilating and air conditioning fields.

The conception of the first passenger diesel locomotive immediately presented a major problem in heating. Heretofore the steam locomotive had been an almost inexhaustible source of heat, limited only by pressure and the size of the steam distribution lines. While a very large amount of heat was present on the diesel locomotive and wasted to the atmosphere through the radiators and exhaust manifolds, no practical method of harnessing this heat was, or is known, within the limitations of size and weight restrictions. As all railroad cars were heated by steam, some source of steam was necessary.

A vertical fire-tube boiler was first used but size and weight became a premium and it was necessary to find a new method of generating steam. The result was an entirely new concept of steam generation resulting in the first successful straight through steam generator. Such a generator had definite advantages over a conventional boiler. Since no water level is maintained and no water drums are used, the size of the water containing portions may be reduced to a minimum, consistent with high heat exchange practice. The small volume of water gave other advantages of safety. The mass of water in the coils at or near vapor temperatures is so small that a complete rupture of the coil may occur without any possibility of a steam explosion. Since cubical size was extremely limited, combustion volume was likewise limited and heat release per unit of combustion volume had to be increased greatly over standard practice. It was felt that such intensity could be achieved by burning in a high pressure chamber. Heat release on these generators is in the neighborhood of 1,000,000 Btu per cubic foot of combustion space, approximately twenty times normal practice. Fig. 1 shows a typical steam generator now in use on diesel locomotives of American railroads. This particular steam generator has a normal rating of 4500 lb of steam per hour and is capable of a maximum output of 4800 lb of steam per hour.

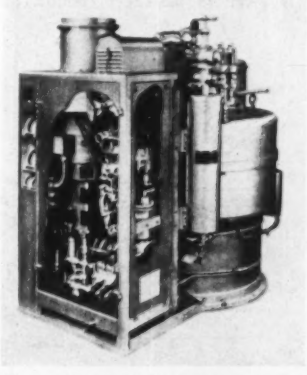

Fig. 1—4500 lb per hour steam generator

These generators are continuous coil type steam generators, down fired with the same diesel fuel as is used on the power engines. Sizes range from 500 lb of steam per hour to 4800 lb of steam per hour at varying pressures from 75 to 300 lb per square inch. Steam quality is in the neighborhood of 99.8 percent. Feedwater is pumped by semi-high speed triplex pumps to a water pressure regulator which bypasses water when steam pressure is within the control range. The water flows from the water pressure regulator to a hydraulic servo mechanism that proportions fuel and air to the volume of water passing through the control. Here then is the major difference between a steam generator and conventional boiler. Water must be fed to the generator in exact accordance with steam demand, and practically all water entering the generating coils must be converted to steam in a single pass. No water level is maintained, therefore, flow controls must be used to regulate water, fuel and air. The volume of water flowing through the water portion of the servo control positions an oil valve which operates the hydraulic mechanism. Hydraulic pistons position a

*Executive Engineer, Vapor Heating Corp.

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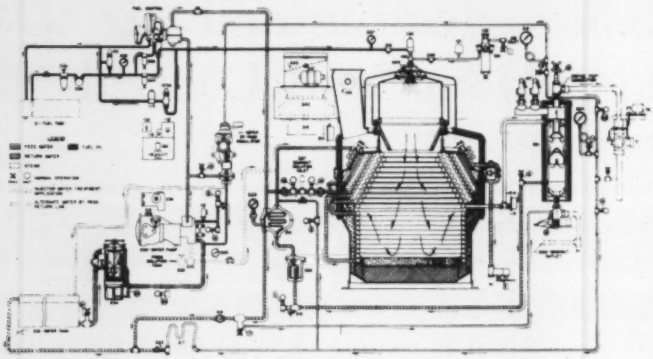


Fig. 2—Schematic piping diagram — steam generator

double cam plate to increase or decrease fuel and air. The double cam plate through a sleeve valve balances the hydraulic pistons to bring the system to equilibrium. The water then enters the steam generating coils where it is converted to steam. Any excess water is removed by a centrifugal steam separator to insure dry steam. The excess water, traveling at high velocities through the coils, carries the scale forming sludge into the separator where it is separated and wasted to the ground by automatic periodic blowdowns.

Atomization is by compressed air and a high pressure fan furnishes combustion air. A steam temperature limit control meters oil to the burner nozzle if lack of water causes superheating. Standard safety controls are used and *ASME* practices and codes are observed throughout the manufacturing procedures. Thermal efficiencies are approximately 82 percent. Fig. 2 shows a typical schematic piping diagram of the type of steam generators now generally in use on American railroads.

The rules governing engineers and firemen prohibit the fireman from leaving the cab of the locomotive when the train is in motion. Therefore, all controls must be entirely automatic and in addition, remote alarms are used to indicate any failure of the generator or its appliances. Shut down of the unit upon arrival at terminals is accomplished by remotely operated valves which shut off the main steam line and, in turn, cause the generator to reduce its output to zero.

Periods of maintenance may well be irregular and at extended periods, some railroads covering 5000 miles of operating before bringing the diesel locomotive into a terminal for maintenance. For this reason preventive maintenace is practiced and routine work highly systematized.

Other sources of heat have been used for railroad cars, some aimed at relieving the diesel locomotive from the problems of carrying water necessary for the production of steam and the additional fuel necessary for the steam generator. Others have been the outgrowth of electrical capacity problems. The advent of the modern high speed, light weight, passenger car has brought increased competition between neighboring rail lines. More and more consideration is given to passenger comfort and increased use of electrical equipment has been the result. Capacities of air conditioning equipment have increased from 5 and 6 tons to from 7 and 8 tons per car. Better lighting and more of it has been used. Radios, record players and intercommunication systems have imposed increased electrical loads. Diners are being built with entirely electrical kitchens. This constant increase in electrical load has increased the sizes of axle driven electrical generators to their limit. Axle load limits have been reached and alternate sources of electrical energy are being sought; on long transcontinental trains frequently a major portion of one diesel locomotive is being used just to drive axle generators and the locomotive contributes relatively nothing to the total tractive effort of the locomotive combinations.

In some cases head end electrical generating plants, diesel engine driven, have been used, but the problems of transmission between moving cars has not been satisfactorily solved.

More and more applications of individual engine generator sets on passenger cars are being made to solve the problems of increased electrical loads. Propane engines are used on some railroads for generating electrical energy and also for air conditioning. Much work is being done at the present time on diesel engine generator sets and in some of these cases, the waste heat from the diesel engine is being recovered. In some applications, the coolant water of the diesel engine is used as

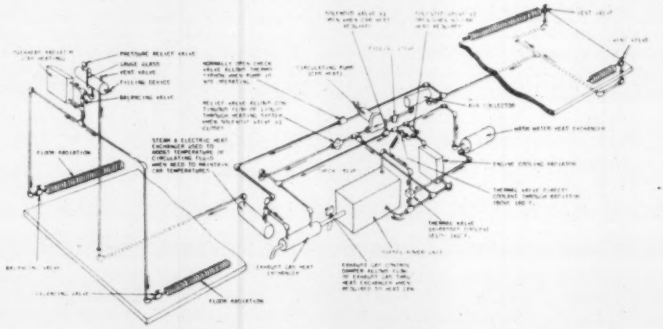


Fig. 3—Schematic diagram — waste heat recovery

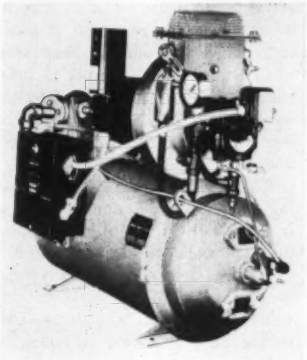


Fig. 4—150,000 Btu per hour water heater

the heating medium within the car. In other applications, a liquid to liquid heat exchanger is used to heat water or a mixture of water and ethylene glycol which in turn is used as the heating medium. The largest single electric load is the air conditioning system, therefore, there is excessive capacity during non-air conditioning seasons. The energy may be used during the heating season as an auxiliary source of heat. Fig. 3 shows a typical schematic piping diagram of a waste heat system, using a diesel engine generator set placed underneath the car as the source of power and heat.

Thermostatic controls are arranged to use the available heat in predetermined sequence. First electrical current is used either by strip heaters in the overhead heating system or immersion heaters to heat the heating fluid. This insures maximum loading on the diesel engine. Next, full use is made of the heat wasted to the coolant with thermostatic controls insuring constant engine manifold temperatures. Finally, the waste heat in the engine exhaust is used by means of a gas to liquid heat exchanger controlled by a bypass butterfly valve in the exhaust line. The sizes of the engine generator sets used range from 20 to 35 kw but full use of all recoverable heat will not satisfy the full heat load in colder climates and steam must still be used to supplement the engine heat unless an oil-fired water heater is used to make up any deficiencies. Such a heater as shown in Fig. 4 may be used alone as the heat source, or in conjunction with the heat from the axle generators or engine generator sets. Rated output is 150,000 Btu per hour at 8 gpm flow of liquid and up to 185,000 Btu per hour at flows of 20 gpm and upward, as normally used on passenger cars. Such heaters are also used to control automatically, through thermostats, the coolant water temperatures on diesel freight and switch locomotives during periods of nonuse to eliminate the need for engine watchmen and to reduce maintenance costs resulting from prolonged operations at slow idling speeds.

Another solution to the problem of furnishing an individual source of heat for each car has been proposed and is being studied and tested at the present time. This is an offshoot of the socalled *vapor phase system* as applied to internal combustion engines. It consists generally of operating the engine at coolant manifold temperatures above the vapor temperatures at atmospheric pressures. The coolant flowing from the engine would be allowed to flash into steam and the steam condensed either in the heating system or undercar condensers. Higher engine efficiencies would result as well as increased overall thermal efficiency of the system. Pump heads seem, at the present, to be the limiting conditions when handling very hot liquids. There are also problems to be studied concerning the coring of the coolant water through the cylinder block of the diesel locomotives to avoid cavitation of the hot coolant liquids.

At present, however, approximately 95 precent of all passenger cars are heated with steam, therefore, its distribution and control are the major considerations of all railroad heating and air conditioning engineers. Fig. 5 shows a typical steam heating layout for an open section coach passenger car. High pressure steam is transported through the cars by 2½ in. main steam lines and through flexible metallic conduits between cars. Steam pressures vary from 125 to 250 lb per square inch. Total steam demand is greatly in excess of the total of the heat demand of the individual cars. The calculated heat load of individual modern passenger cars at –20 F with a 40 mph wind is approximately 180,000 Btu per hour, or about 185 lb of steam per hour. Actual tests indicate steam consumption may be as high as 350 to 400 lb of steam per hour per car. The difference in these figures is the loss due to main steam transmission lines and flexible metallic conduits, this loss increasing as temperature gradients increase.

The high pressure steam is reduced in pressure and fed thermostatically to the radiation at pressures from 3 to 12 lb. Condensate is wasted to the ground at temperatures of approximately 200 F.

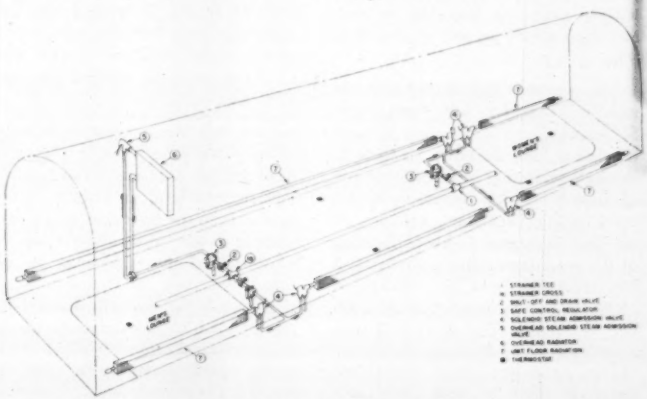


Fig. 5—Heating layout — open coach

Nowhere in industry does the heating and air conditioning engineer have more difficult problems to solve and more precise control specifications to meet. The space to be controlled is exposed on all six sides. It may be, and is propelled through space at speeds up to 100 mph. The same required equipment must be able to operate and control continuously from temperatures of 120 F in desert areas to –60 F in Canada or the Pacific Northwest.

Only one manual switch is used on the majority of passenger cars. This is a simple *Off* and *On* switch. Thermostatic controls determine whether the car will be heated, ventilated or air conditioned. A 1 deg ventilating dead band is usually used between heating and cooling, although cooling will extend into the heating band. For example, a car will be heated to 75 F, ventilated to 76 F and air conditioned from 76 F, although the car may be cooled down to as low as 68 F. It is evident that controls must respond within less than ±0.5 F to avoid hunting from heating to cooling and the reverse. An outside thermostat is used for positively locking out the compressor circuits when outside ambient temperatures are above a predetermined level.

Car Heating Design

The heating system of a railroad car may be divided into three separate parts: an overhead forced air system, a side wall radiation system, and the radiant heating at the floor line.

The overhead forced air system is usually designed to take from 25 to 50 percent outside air, filter it, heat or cool it, and deliver it to the car through aspirating or diffusion types of outlets. With increases in air conditioning capacities, volumes of air have increased to avoid frosting of the evaporator coils. Air handled has increased from an average of 1500 cfm on pre-war cars to 2400 cfm on postwar cars. Since duct sizes have remained relatively fixed, velocities have increased and air temperatures must be held fairly constant at the outlet to avoid hot and cold drafts. On pre-war cars air intake hoods and filters increased in static pressure with the speed of the car and the result generally was 100 percent recirculated air at speeds of 50 mph and over. Since the war, intake hoods have been designed with a fairly even static head resulting in use of outdoor air at high speeds and increasing the total heat demand of the system.

If outdoor air intakes do not function at high speeds and exhaust fans are used, it is evident that a negative pressure might result in the car body and that is the case in a large proportion of the present railroad cars. Air leakage is increased tremendously and difficulty is encountered in keeping end doors closed. The problems imposed on the control system under these changes of air distribution require careful study and extreme accuracy to overcome. To overcome the problems of negative pressure and the resultant dirt problem, some cars have been pressurized to insure correct air distribution and cleanliness. The plenum chamber is sealed and no exhaust fans are used. Leakage stacks provide air outlets and air pressures of fractions of an inch are maintained throughout the car body.

All types of filters have been used including electrostatic, centrifugal and activated carbon. Those used most generally, however, are the wire mesh oil dipped type.

The increasing volumes of air handled in overhead systems has increased heating coil sizes from a pre-war average of about 58,000 Btu per hour to about 100,000 Btu per hour on new cars.

Even with the increase in volume, velocity and heat input in the overhead system, tests prove conclusively that the overhead air stream cannot penetrate to the floor line of the cars without raising discomfort levels to unbearable limits. It must be remembered that conditions in railroad cars differ radically from those encountered in industrial or domestic service. Passengers sit next to, or in actual contact with, cold external walls and windows. Distances from air outlets to passenger contact are at a minimum. Outlets may be directly over the passenger at a distance of 5 ft from the head level when seated. The inability to penetrate to the floor line necessitates the use of other heating systems to insure warmth at external walls and floor line.

A side wall heating system consisting of finned radiation is used to insure a vertical film of hot air along the side walls of the car. Such a system has been used for many years in railroad cars and while the full value of the system was not realized, its use became almost universal.

Before air conditioning became widely used, windows on all railroad cars were single glazed and also storm windows were used in cold weather. At that time, windows were approximately 40 percent of the side wall of the car adjacent to the passengers. These windows had large leakage factors and a high velocity vertical air film was the only method of counteracting such heat losses. Today windows make up approximately 80 percent of the car side wall exposed to passengers, but are double glazed and are well sealed in rubber. Radiant losses and gains have replaced the convectional losses and different methods are used to counteract these losses. In addition, heat distribution is better understood and may be more closely calculated.

Today the action of the side wall radiation is divided into two functions, that of convectional currents rising vertically along the outside wall and the radiant heat radiating in straight lines from the radiator guards in the form of infra-red rays.

It can be visualized then, that the air currents in the confined 10 ft wide space of a railroad car are at right angles to each other. A main air stream from the overhead system follows a path longitudinally of the car body and the convectional air currents from the side wall radiation move transversely and at right angles to the main overhead stream. These air movements become more complicated in multiple room cars but the main streams still retain their individual characteristics.

At one time it was felt that the convection currents from the side

wall radiation kept the ankles and feet of passengers warm. It is now realized that the air currents moving from the aisle toward the side wall radiation must of necessity, be considerably cooler than the warm air delivered from the overhead system or the air rising from the side wall radiation. Today the value of infrared radiation is fully recognized and indeed the raising of mean radiant temperatures to comfort levels has been a goal for some years. In 1934 the warm air from the side wall radiation was first used behind wainscot sheets, being released at the window sill, thus giving a radiant shield between passengers and side walls and making effective a film of rising warm air on the inside of the windows. Today many cars are making use of such panel heated construction to improve heat distribution and increase the efficiency of the heating system.

In addition to the foregoing problems which must be solved by the control engineer, it has been found necessary to zone individual cars. End doors of the cars are constantly being opened, thus allowing cold air currents to enter the car body. This is especially objectionable at the non-recirculated end of the car where these cold air currents may easily affect passengers adversely in the first two or three seats. For this reason, radiation at the end of the car is controlled separately by thermostats in that zone. In addition, lounge rooms for men and women are zoned separately as well as individual rooms in multiple room cars.

Additional zoning is used on many railroad cars which travel from east to west across the country and from north to south on long trains. Here recognition is given to the differences between sunny and shady sides of the car, and, consequently, thermostats on each side of the car regulate the amount of heat input to the car in accordance with radiant heat being added to that side of the car by sun effect. A particularly difficult problem in radiant effect is found in the socalled *dome cars*, now being used on many of the railroads. These cars are double-deck cars with the upper deck being in the form of a bulge at the roof line, the outer skin of the bulge being approximately 95 percent glass. Here radiant effect of sun can influence greatly the heating and air conditioning loads in the car, and thermostats sensitive to radiant heat are used to adjust the normal car thermostats to balance the heat input to the radiant heat imposed on the car structure.

Thermostatic control theories are fairly well defined although changes in seating arrangements and partition locations constantly must be analyzed anew. In general, it is well accepted that the overhead heating system must be fully used at all times to conform to the standards of ventilation set up by the U.S. Public Health Service. Thus the overhead system is used to heat the car until outside conditions, as indicated by inside temperatures, indicate the need for additional heat requirements from the side wall heating system. To accomplish this, side wall heating is tied in thermostatically to the overhead system and cannot be used except when a call for heat is recognized by the overhead heating thermostats. Such a system insures balance of heat and allows temperature levels to be maintained within 1 deg bands from end to end of the car and from floor to ceiling.

Bimetallic thermostats do not have the precision of control necessary for railroad requirements, nor will they stand the high vibration and shock conditions encountered. A mercury thermostat specially designed to meet these conditions is used almost universally for control. Where extremely cold temperatures are encountered, a mercury thallium amalgam is used in place of pure mercury in the thermostat. A unique feature of the thermostat is the fact that a secondary mercury bulb may be used. This bulb is wrapped with a resistance winding and insulated to be unaffected by ambient temperatures. The result is a thermostat which may be influenced by ambient temperatures or by artificial heat applied electrically through the resistance winding of the secondary bulb. The secondary bulb may be used in two ways. A steady amount of current may be imposed on the heat winding to set the thermostat down below its fixed temperature setting. Thus an 80 deg thermostat may be used as a 78, 76, 75 deg thermostat eliminating the need for an infinite number of fixed setting thermostats. By using a potentiometer in series with the heat winding, a controllable thermostat results. The heat winding on the secondary bulb may be used in another important fashion. By placing a resistance in parallel with the fixed resistance used for set down and having this resistance cycled by the relay operated by the thermostat, additional heat may be imposed on the secondary bulb when the mercury column is not in contact with the control point. When the mercury is in contact with the control point, a relay cuts out the cycling resistance and allows ambient temperature to affect the thermostat alone. By weighting the cycling resistance to the latent heat in the radiation being controlled, the heat input may be shut off at a point where the remaining latent heat in the radiation will bring the temperatures to the control point without overruns or underruns. While many thermostats now use this feature, basic patents restricted its use to such mercury thermostats until recently.

Mercury thermostat-relay combinations control solenoid steam admission valves, electric strip heaters, oil fired heaters and, through interlocks, control the air conditioning equipment.

Air Conditioning Systems

While electro-mechanical air conditioning equipment is most widely used, there are many cars equipped with steam jet systems and many which still use ice activated systems. It has been found that, generally, dry bulb control will give satisfactory results although reheat has been used in several ways. Overhead steam radiators have been used as well as electric strip heaters. In some cases reheat is under control of the occupant of a single room by means of a small electric heater in the duct

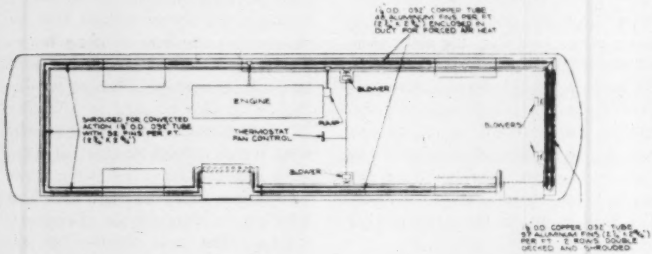


Fig. 6—Bus layout

ESTIMATED BTU

Rear Section — no fans
16 ft at 850 Btu per foot — 13,600 Btu

Side Sections — fan each side
25 ft at 2000 Btu per foot — 50,000 Btu

Front Section — 2 fans
2 rows 57 fins per foot — 14 ft at 3500 Btu per foot — 49,000 Btu

Total heat output at 170 F water = 112,600 Btu

outlet of the individual room. In addition, wet bulb control has been used in some cars and combination wet and dry bulb control has been used.

The same progress and forward thinking is being applied in other fields of transportation. In the bus industry more and more thought is being given to passenger comfort and modern heating and air conditioning controls are being applied. Normally the buses make use of the heat wasted by the engine to the cooling liquid for heating the interior of the bus. The coolant is pumped through various types of radiation, some in the form of unit heaters with fans to force air through the radiation core. In others, the radiation is distributed at the floor line and circulation is by convectional currents. Proper distribution of the heat uniformly throughout the bus body is being given more and more consideration in order to insure comfort levels at all seating positions in the bus. Fig. 6 shows a modern heating arrangement for a typical bus. While under normal operating conditions, the heat rejection to the coolant liquid by the bus engine is sufficient to heat the bus properly, there are periods during which heat rejection is at too low a level to insure comfort within the bus body. This occurs at stopping points for loading and discharging of passengers and on long down hill runs where the bus engine is not being run. In some western states, these down hill runs may extend for lengths of 10 to 14 miles, with the bus engine operating not above idling speed, thus limiting the heat rejection to the coolant liquid and, in turn, the heat input into the bus. Some consideration has been given to the use of booster heaters for such periods when the heat rejection from the bus engine is not sufficient to make up the heat demand to the bus body. Oil fired or gasoline fired, small compact water heaters similar to that shown previously in Fig. 4 are used to make up the additional heat requirements during engine idling periods. These booster heaters also are used for standby protection for the bus during periods of non-use and when buses must be stored in outside storage lots during freezing weather.

Modern street cars of the PCC type make use of otherwise wasted heat from dynamic brakes and by means of thermostatically controlled dampers, either reject the heat or admit it into the car body.

Aircraft Applications

Aircraft equipment and controls, although necessarily more complicated and compact, also follow modern theories of control. Aircraft are heated and cooled by means of mixing dampers used to correct the proportion, cold and hot air, to satisfy temperature requirements in the cabin or body of the airplane. The source of the hot and cold air varies with various types of planes. In general, reciprocating engine driven airplanes use ram air as a cooling medium and ram air which has been heated by a gasoline heater for the hot source. The cold and hot air then is mixed to give a predetermined final temperature in the aircraft body. In general, cooling equipment is not used on commercial types of airplanes. The ram air cold source is sufficient to satisfy the cooling demands of the cabin or passenger carrying space. In military aircraft however and more especially in modern jet planes, it is necessary to mechanically cool the air so that a positive source of refrigeration is available at all times. On jet powered military aircraft, air is bled off from turbines and used as the hot source. A portion of this air is then fed through a cooling turbine where the air is forced to drive the turbine, giving up its energy and leaving the turbine as cold air. Here again the hot and cold air is mixed to satisfy the demand of the cabin. Thermostatic controls are now standard equipment on practically all aircraft for cabin heating and cooling, for de-icing purposes both on wings and cabin windows, for carburetor intake air heating, cowl flap controls and oil cooler controls on reciprocating engine type aircraft, and for cabin heating, de-icing and cooling on jet powered aircraft. Rate of change of temperatures in aircraft may be as high as 50 deg per second and here mass must be reduced to a minimum in the temperature sensing element. Electronic temperature controls are being used in increasing numbers, although some jet aircraft have cabin heating controls, using the double mercury bulb thermostat because of its low cost and simplicity.

Conclusions

It is evident that even though it is not a high mass production, highly competitive industry, the field of transportation heating, ventilating and air conditioning has kept pace with the most forward thinking and has offered valuable contributions to the general knowledge in this field of engineering. The unexcelled policies of service to the country and public of the transportation industries will insure that this, as well as other fields of engineering endeavor, will continue to progress.

Fun and Fellowship At Philadelphia

WHILE technical matters and Society business occupied the positions of major importance at Philadelphia and were fully reported in the March issue, ample opportunity for good fellowship was provided through the excellent program prepared by the Committee on Arrangements of the Philadelphia Chapter.

Welcome to Philadelphia

A Reception and Tea, to welcome the members, their wives, and guests attending the 57th Annual Meeting, was held on Sunday, January 21, from 4:00 to 6:00 p.m. in the Reception Room on the 18th floor of The Bellevue-Stratford. The Ladies Committee, of which E. H. Dafter was Chairman, assisted by G. F. Bertrand and R. F. Smiles, greeted the 300 guests who attended the opening affair of the Liberty Bell Meeting.

Music was provided by an accordionist, and Mrs. George E. Tuckerman, whose lovely voice added much to the enjoyment of the occasion, graciously sang several delightful selections.

The ladies who poured were Mmes. Lester T. Avery, William P. Culbert, John Everetts, Jr., Charles S. Leopold, Ludwig Mack, Rush D. Touton.

The following members of the Ladies Committee acted as hostesses: Mmes. Robert S. L. Arnold, M. Everett Barnard, George F. Bertrand, Merrill F. Blankin, Francis H. Buzzard, Lloyd M. Church, Edwin H. Dafter, C. Fred Dietz, H. Berkley Hedges, Joseph H. Hucker, Robert F. Hunger, Melville G. Kershaw, J. Owen Kirkbride, Harry H. Mather, John W. McElgin, Lawrence E. Moody, Albert J. Nesbitt, Wirt S. Scott, Earle K. Wagner.

Welcome Luncheon

The Welcome Luncheon was held on Monday, January 22, in the Ballroom of The Bellevue-Stratford, with A. J. Nesbitt, Chairman of the Committee on Arrangements, as Toastmaster.

In addition to the speaker, Dr. Lillian M. Gilbreth, guests at the speakers' table were Merrill F. Blankin, Honorary Chairman; Francis H. Buzzard, Vice Chairman; Charles S. Leopold, member of the Council; Society Officers: Lester T. Avery, Pres., Lauren E. Seeley, First Vice-Pres., Ernest Szekely, Second Vice Pres., Reg F. Taylor, Treas.; Philadelphia Chapter Officers: John W. McElgin, president, Earle K. Wagner, first vice president, M. Everett Barnard, second vice president, C. Fred Dietz, treasurer, Lloyd M. Church, secretary.

Mr. Nesbitt introduced Dr. Gilbreth by referring to her fame as a mother, humanitarian and engineer. He reviewed some of the accomplishments of her career, and referred to the fact that each of 12 children had received a college education, and that during the years of her engineering career, which had been carried on simultaneously with that of raising a large family, she had become one of the most famous women in the United States and the world.

Dr. Gilbreth spoke on the subject, *Management Problems in the Home*. In the first part of her speech, Dr. Gilbreth spoke of the manner in which the soldiers, returning from service, and their wives had met the difficult housing situation, and by their adaptability had solved the problem of living and raising their families while completing studies in colleges and universities without development of any of the domestic difficulties which many psychologists had feared for them. Evidence of this adaptability, according to the speaker, was found in the sharing of all household tasks by both husband and wife, each doing whatever was necessary to promote the welfare of the family. New ideas for home management were the result of such cooperation.

The speaker also related how representatives of a large number of groups had cooperated in planning a kitchen wherein a mother with a heart ailment could carry on most of the duties performed by a person in good health. Many other home management problems were discussed, and in all of them the speaker revealed enthusiasm and energy which made an unusual impression on the audience.

Tea at Wanamaker's

On Monday afternoon, January 22, a Ladies Tea with Entertainment was held in the Greek Room of John Wanamaker's. There was a musical program, and one of the world's greatest mentalists, Dr. L. D. Ablo, was quite successful in confounding the ladies with his unique presentation of magic and his astounding ability in reading the thoughts of almost the entire audience. There were 274 ladies present.

The hostesses were: Mmes. Albert J. Nesbitt, Francis H. Buzzard, Edwin H. Dafter, Melville G. Kershaw, John W. McElgin, Earle K. Wagner.

Illustrations showing entertainment functions were furnished by J. Donald Kroeker, Portland, Ore., and William Wallace II, Durham, N.C.

A Night with the Pennsylvania Dutch

On Monday evening, entertainment was in the form of *A Night with the Pennsylvania Dutch* held in the Crystal Ballroom of the Benjamin Franklin. A Pennsylvania Dutch Supper was served buffet style from 6:30 p.m. to midnight in the adjoining Betsy Ross and Franklin Rooms.

At 8:30 p.m. a play entitled *Papa is All* was presented by the Palette Players of the Cheltenham Township Art Center. Dancing followed the conclusion of the play and was featured by a Square Dance with a Dutch old-time Caller.

During the intermission several members participated in the *Swap Shop* receiving many varied and surprising gifts.

At midnight several entertaining acts of vaudeville were presented.

Square dancing during "A Night with the Pennsylvania Dutch" at Benjamin Franklin Hotel, 57th Annual Meeting in Philadelphia

Brunch and Tour

On Tuesday morning, January 23, the ladies were invited to a *Brunch* at the Hotel Warwick, which was followed by a bus tour of old and new Philadelphia and historic Valley Forge. The tour included stops at Independence Hall, Betsy Ross House, the Chapel at Valley Forge, and Washington's Headquarters. About 342 members and guests took the tour.

The hostesses were: Mmes. Merrill F. Blankin, William P. Culbert, H. Berkley Hedges, C. Fred Dietz, Joseph H. Hucker, Robert F. Hunger, J. Owen Kirkbride, Harry H. Mather, Rush D. Touton.

John Kingsley, W. H. Heagerty and Mrs. William M. Wallace, II at Bookbinder's

Luncheon and Fashion Show

The Hotel Warwick set the scene again for another gala party on Wednesday, January 24, for a Luncheon, and a Fashion Show, *Heavenly Lilacs and Winter Bouquet* by Bonwit Teller. The ladies, 262 in attendance, were happily imbued with the luscious bon bon shades of the gowns, ranging in hues from the deepest of violet to the palest of pink; an ice cream setting, against the background of the Pink Ballroom.

Hostesses: Mmes. Charles S. Leopold, M. Everett Barnard, Lloyd M. Church, John Everetts, Jr., Joseph H. Hucker, Lawrence E. Moody, Ludwig Mack, Wirt S. Scott.

Past President's Dinner

Eight Past Presidents of the Society met at the Union League of Philadelphia at 7:00 p.m., Tuesday, January 23, for their Annual Dinner. Those who were present to enjoy a lobster dinner were A. E. Stacey, Jr., Homer Addams, M. F. Blankin, S. H. Downs, W. L. Fleisher, H. P. Gant, L. A. Harding and G. L. Tuve.

Mrs. John E. Haines, Minneapolis, L. P. Saunders, Lockport, N. Y.

Merrill Blankin, toastmaster at Society's Banquet in Philadelphia, with Pres. Lester T. Avery, Mrs. Lauren E. Seeley and Mrs. Ernest Szekely

Cameron Ralston delivering a talk on The Plagues of Democracy at Banquet during 57th Annual Meeting in Philadelphia

Homer Addams presenting Past President's Emblem to Lester T. Avery at Society's Annual Banquet in Philadelphia, with Mrs. Seeley and Mrs. Szekely at right

Dean L. E. Seeley presenting plaque to A. V. Hutchinson, commemorating his 25 years as secretary of ASHVE

Banquet

The 57th Annual Banquet was held in the Ballroom of The Bellevue-Stratford, 7:00 p.m., Wednesday, January 24th. Merrill F. Blankin, Past President of the Society, and Honorary Chairman of the Committee on Arrangements, was the Toastmaster. Attendance at the Banquet was limited by the capacity of the Ballroom, to 1100 members and guests. The speakers' table was arranged in two rows, and placed in an attractive setting resembling an outdoor garden.

The Invocation was made by Dr. Walter J. Leppert of the Philadelphia Council of Churches, after which the National Anthem was sung.

Dinner music was provided by Howard Lanin and his orchestra, the music being interrupted only to permit a delegation from Oregon Chapter to give a cordial invitation to the members to attend the Semi-Annual Meeting 1951 in the City of Roses, Portland, July 2 to 4. The invitation was presented in song by eight Chapter members, led by Chapter President R. C. Chewning.

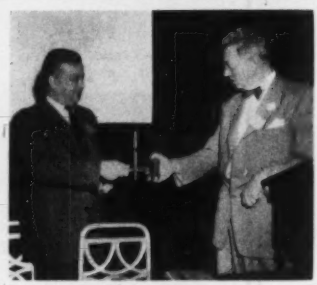
A cordial invitation to the next Annual Meeting in St. Louis was given by Chapter President, J. S. Rosebrough.

F. Paul Anderson Medal

Announcement of the award of the F. Paul Anderson Medal to Past President Samuel R. Lewis, consulting engineer, Chicago, Ill., was made by President Avery, who gave a brief statement of Mr. Lewis' accomplishments.

Mr. Blankin invited Homer Addams, Past President and Charter Member of the Society, to present the Past President's Emblem to retiring President Lester T. Avery. In making the presentation, Mr. Addams referred to the great honor which comes to those who hold the Past President's Emblem. Mr. Avery expressed his appreciation of the honor of receiving the Emblem, and referred to the great pleasure he had derived from his association with the members of the Society, and from his part in serving the Society.

Council holds first 1951 meeting January 25 at The Bellevue-Stratford



Retiring President Avery presents gavel to 1951 President Seeley

President-Elect Lauren E. Seeley read a citation and presented a plaque to A. V. Hutchinson in recognition of his loyal service of 25 years as secretary of the Society.

The speaker of the evening was Cameron Ralston, Gettysburg, Pa., whose address on *The Plagues of Democracy* was liberally sprinkled with stories and anecdotes emphasizing the points of his speech.

Mr. Ralston, in his speech, named what he called the plagues of democracy. *First* — the challenge to the authority of the teachings of our fathers. *Second* — the hatred of man for man (not racial or religious bitterness, but the class hatred which has grown out of economic conditions). *Third* — the terrific aversion to work. *Fourth* — the pursuit of pleasure.

In conclusion he named, what he termed the *greatest plague of all*, the substitution of the material for the spiritual in man, and then stated that to keep our great country functioning as the best nation and the hope of mankind, we must have three devotions: a new devotion to the Ten Commandments; a devotion to the principles of the Sermon on the Mount, and a new respect for the Constitution of the United States.

At the conclusion of Mr. Cameron's address, the ballroom floor was cleared for dancing which continued until 1:00 a.m.

Bus Ride to Atlantic City

The final entertainment for the ladies was the trip to Atlantic City. Guests boarded the buses at The Bellevue-Stratford and Benjamin Franklin at 10:30 a.m. There was a brief stop midway, at Hammonton, N. J. for refreshments before proceeding on to Atlantic City. Luncheon was served the 76 guests in a private dining room, overlooking the Atlantic Ocean, at Captain Starn's Restaurant. Souvenir pictures were taken of the guests during luncheon by the restaurant's photographer. After luncheon the guests had ample time to walk the boards, ride in the chairs, browse around in the shops, or just sit and enjoy the brisk ocean breezes before the return trip to Philadelphia at 6:00 p.m.

Hostesses: Mmes. George F. Bertrand, Robert S. L. Arnold, Edwin H. Dafter, John Everetts, Jr., J. Owen Kirkbride, Ludwig Mack, Roy H. Smiles, Wirt S. Scott.

Exposition Was Industry's Largest

Three hundred and fifty exhibits at the Tenth International Heating & Ventilating Exposition testified to the remarkable stature and wholesome outlook of an industry that is achieving new heights. The exposition, largest of its kind ever held, occupied all the space available in the Commercial Museum, Exhibition Hall and extended into the Convention Hall, at Philadelphia, Pa., January 22-26. It was managed by the International Exposition Co. under the auspices of THE AMERICAN SOCIETY of HEATING & VENTILATING ENGINEERS.

The exposition was opened officially by ASHVE President Lester T. Avery, assisted by President-Elect Lauren E. Seeley, Charles L. Todd, executive director of the Philadelphia Convention and Visitors Bureau, and Charles F. Roth, exposition manager.

The exposition drew attendance from a wide area, with visitors registered from all parts of the United States and many foreign countries, mounting by the end of the exposition to a total of nearly 18,000. Members of the Society, and architects, professional engineers and manufacturers from the many industries all of whom are vitally interested in heating, ventilating and air conditioning equipment, were strongly in evidence throughout the week. An even larger body of visitors represented heating and ventilating contractors and dealers, many of the latter seeking to expand their lines to meet the increasing requirements introduced by the changing trends in manufacturing processes which employ heating, cooling and ventilating equipment, and also by advances in the construction industry, which affect heating and ventilating problems in many ways.

Heating Equipment

Taken as a group, the exhibits of heating apparatus constituted the most comprehensive display of similar appliances ever gathered under one roof. They ranged from the simple hand-fired furnaces through a variety of stokers to examples of the scientific flat-plate automatic burner fostered by the *Anthracite Institute*

through its extensive research program. They included many examples of oil burners, coal-to-oil conversions and oil-to-gas conversions.

The methods of heat extraction and distribution were as numerous as the methods of combustion. Cast-iron and steel boilers were shown in a variety and ingenuity of designs. The number of types and sizes which most of the manufacturers require to complete their lines continues to be remarkable.

Most modern and ingenious were the designs of forced-air furnaces, especially the compact arrangements devised by several exhibitors for small homes.

New developments were shown to improve and simplify ductwork including new methods of fabrication and the employment of new materials, numerous examples of new design in registers, grilles and diffuses. The concept of perimeter heating with forced air has been taken up by several manufacturers with interesting results, especially in respect to designs for basement-less houses in which the perimeter ducts and floor registers set snug to the wall and no more than four inches wide, are a distinctive feature intended to combat heat leakage from the base of the walls and the edge of the floor slabs.

Baseboard radiators and convectors for steam and hot water claimed a great deal of attention and exhibited commendable variety, affording the architect and builder plenty of latitude for choice to suit the arrangement of rooms. So, too, did the large assortment of wall type convectors.

Air Moving Equipment

Incorporated among the exhibits at Philadelphia were many types of fans and blowers particularly adapted to the needs of manufacturing plants, warehouses and public buildings and ranging down into the styles designed for application in homes, such as attic and window fans, as well as wall fans, designed to force warm air from heated into unheated rooms.

In the same general category were the exhibits of air filtration apparatus, ranging from the numerous types of filters designed for incorporation in domestic heating and ventilating units to the several examples of large units intended for industrial applications and installation in large buildings. Significant among the latter were at least three displays of electrostatic air filtration apparatus.

The 10th International Heating and Ventilating Exposition officially opened January 22 by Lester T. Avery, president 1950. Looking on are Lauren E. Seeley, president 1951, Charles L. Todd, executive director of the Philadelphia convention and visitor's bureau, and Charles F. Roth, exposition manager.

One manufacturer of plumbing and heating equipment has just added a summer cooling unit for installation as an adjunct to the more conventional domestic heating plant and has incorporated in it a compact electronic precipitator-filter unit. Another exhibitor showed an automatic lint filter for textile mills, in which the medium is a single ply sheet of specially fabricated paper which unrolls across a screen and is caused to move slowly as air resistance builds up, thereby renewing the surface continuously.

Cooling Units

Room coolers revealed an increase that is very marked over the past several years.

Among supplementary units at the exposition was a self-contained *liquid chiller* unit, designed to provide cooling for installation in conjunction with hot water, steam or warm air heating equipment, the only extra requirements being electric and water connections. Another departure was an internal-combustion-motor driven compressor for air conditioning and refrigeration designed to operate on gas fuel.

For industrial and other large capacity installations, one exhibitor offered a *capillary air washer*, consisting of a series of capillary cells composed of finely-packed glass filaments, forming an air filter over which water is sprayed.

One of the largest manufacturers of air conditioning, heating and ventilating equipment displayed a new hermetic centrifugal refrigeration unit.

Specialties and Controls

One special device shown is applicable to forced hot water or radiant heating systems as a mechanical mixing valve to blend the cooler return water with hot water from the boiler in order to provide the proper temperature adjustment. The valve is actuated by a differential thermo-

stat responsive to water temperature and outdoor temperature.

Among the control systems, one system shown used a combination of outdoor thermostat, indoor thermostat and immersion thermostat operating through an electronic relay to adjust the heat output of the panels.

One exhibitor has developed an indoor-outdoor control which is sensitive to wind change. Still another has developed an automatic control for steam, hot water and warm air systems, in which the length of the heating period in the on-and-off cycle is automatically adjusted to match the weather.

THE GUIDE 1951 PUBLISHED

PROMINENT AMONG the new features of the 29th edition of THE HEATING VENTILATING AIR CONDITIONING GUIDE will be the new ASHVE Psychrometric Chart, printed in two colors, a simplified method of designing panel heating systems, and new data on determination of cooling load caused by heat gain through glass and glass block.

The Psychrometric Chart is plotted on coordinates of enthalpy and humidity ratio in order to secure thermodynamic consistency, and is based on the most recent Goff and Gratch Tables of Thermodynamic Properties of Moist Air and of Water. These tables in the chapter on Thermodynamics cover the range −160 F to + 200 F for moist air, and from −160 to + 212 F for water.

The Panel Heating chapter presents new illustrations of panel construction in a section on application methods. The radiative and convective output of panels may be obtained separately or in combination from formulas or charts, methods of obtaining surface temperatures and unheated mean radiant temperatures are given, and convenient charts to facilitate computation are shown. The design of a floor panel is illustrated.

New tables in the Cooling Load chapter add precision to cooling load calculations and simplify the computation of heat gain. These tables give data separately for the transmitted direct and sky radiation, and for the heat gain caused by convective and radiative exchanges at the indoor surface for a single pane window glass. Factors for correcting single glass values for application to other types of glass and heat gains for various types of glass block walls are tabulated. Cooling load calculations are illustrated.

The new edition is the largest to date, and contains 1048 pages of technical text grouped in 50 chapters under the following headings: I. Fundamentals, II. Human Reactions, III. Heating and Cooling Loads, IV. Combustion and Consumption of Fuels, V. Systems and Equipment, VI. Special Systems, VII. Instruments and Codes.

Some of the significant additions and improvements have been made in the following chapters:

Symbols for use on drawings of heating, cooling and air conditioning system plans have been brought into conformity with the symbols recently adopted as *ASA* Standards.

A fundamental approach to the solution of fluid flow problems has been used, and the relations of familiar formulas to the background principles on which they have been established have been indicated.

The chapter on Heat Transfer has been greatly enlarged to provide concise summaries of available methods of analysis for transient and heat transfer problems. A new table shows convenient formulas for determining approximate unit conductances for convection for several flow systems. Another new table and charts show solutions for net radiation transfer problems.

The up-to-date heat loss coefficients for doors, windows and glass block given in tables on Heat Transmission Coefficients for Building Materials, are based on new data obtained from ASHVE and other research. Data on moisture transfer, a section on conductivity of soils, and a chart for determining soil conductivities, are given.

A method of estimating heat loss from floors on ground, and new factors for heat loss from basement floors and walls have been added.

The sections pertaining to low height chimneys have been revised and clarified in the chapter on Chimneys and Draft Calculations.

Descriptions and suggestions for design of warm air ceiling panel systems and warm air perimeter systems have been added.

A new chart shows friction loss in copper tubing for hot water heating systems.

New data on air duct design use the results of ASHVE research on duct elbow friction loss, and on effect of vanes and splitters in duct elbows. The ASHVE Friction Chart for Ducts is printed with the new ASHVE Psychrometric Chart.

The latest nomenclature and designations for fan drives, direction of rotation and discharge, and motor position, are given in the chapter on Fans.

In Refrigeration, the heat pump section has been revised to include a new table showing factors affecting the use of various heat sources and sinks.

The section on panel heating controls has been enlarged.

A discussion of the characteristics, starting, control and operation of hermetically sealed motors has been added and new charts show the performance of present day motors.

The chapter on Owning and Operating Costs has been rewritten in order to bring the methods of determining cost up to date, and to emphasize factors affecting these costs.

New data on per capita water consumption, the design procedure for water supply piping, the method for sizing cooling water and refrigeration piping and average practice for sizing piping and selecting materials for cooling tower piping have been included.

A description of thermal anemometers has been added in the chapter on Instruments and Measurements.

The list of Codes and Standards has been enlarged to 133 and their source is given.

The new edition was prepared by the Guide Committee composed of A. B. Algren, *chairman*, D. B. Anderson, Nathaniel Glickman, P. B. Gordon, E. F. Hyde, B. H. Jennings, H. R. Limbacher, W. E. Long, P. J. Marschall, Cyril Tasker, *ex-officio*, and C. H. Flink, *technical secretary*.

In addition to technical data, THE GUIDE contains 363 pages devoted to condensed catalog data on the products of manufacturers.

Elaborate cross index sections are included for convenient reference to the text and catalog data.

THE GUIDE is bound in blue cloth, stamped in gold, is 6 x 9 in. in size and is available at $7.50.

Portland Prepares Meeting Program

THE PROPOSED program of special events for the Society's Semi-Annual Meeting in Portland, July 2 to 4, has been announced by General Chairman Bert W. Farnes. Promised are several special events tinged with the flavor of the Great Northwest. The Committee on Arrangements urges all members to come and enjoy that fabulous section of the country and to take part in activities that they will always remember with pleasure. While the Meeting is still some time off, local members are already anticipating a fine turnout.

Four technical sessions and a large number of committee meetings have been planned by the Program and Papers Committee. Subjects will be announced shortly by Prof. E. R. Queer.

The advance group will get under way July 1 with Council and Committee meetings. Those without committee work will be taken on a sightseeing tour by local chapter members.

The opening technical session will be called to order by Pres. L. E. Seeley on Monday, July 2. Technical sessions will follow on Tuesday morning and afternoon and on Wednesday morning.

Portland, setting for the City of Roses Meeting July 2 to 4. Mount Hood is in the background.

The Research Golf Tournament is planned for Monday afternoon, and for non-players, there will be a trip along the Columbia River and a visit to Multnomah Falls. A Hawaiian Buffet Dinner party, with special entertainment and dancing, will take place in the evening.

While the Tuesday morning technical session is being held, the ladies will enjoy a visit to the International Rose Gardens. In the afternoon, there will be a visit to the Grotto and Timberline Lodge, with a Salmon Bake scheduled for late afternoon at the Lodge.

SCHEDULE OF EVENTS FOR SEMI-ANNUAL MEETING 1951
HOTEL MULTNOMAH — PORTLAND, ORE. — JULY 2-4

Sunday—July 1

9:00 a.m. REGISTRATION
10:00 a.m. Council Meeting
10:00 a.m. Committee Meetings
2:00 p.m. Sightseeing tours about City by Chapter Members in private cars

Monday—July 2

9:00 a.m. REGISTRATION
9:30 a.m. TECHNICAL SESSION (three technical papers, to be selected)
12:30 p.m. to 5:30 p.m. Golf Tourney, Glendoveer Course
12:30 p.m. Columbia River trip with snack at Multnomah Falls
1:00 p.m. Committee Meetings
7:00 p.m. Hawaiian Buffet Dinner Party — Dinner-Entertainment-Dancing

Tuesday—July 3

9:00 a.m. REGISTRATION
9:30 a.m. TECHNICAL SESSION (three technical papers, to be selected)
10:00 a.m. Scenic city trip and International Rose Test Gardens
12:00 noon Luncheon
2:00 p.m. Scenic trip — Grotto and Timberline Lodge
4:30 p.m. Buses to Timberline Lodge
6:00 p.m. Salmon Bake at Timberline Lodge

Wednesday—July 4

9:00 a.m. REGISTRATION
9:00 a.m. TECHNICAL SESSION (two technical papers, to be selected)
10:00 a.m. Mollala Round-up
1:30 p.m. Inspections — Country's two largest heat pumps
7:00 p.m. Semi-Annual Banquet

JOURNAL SECTION

A short technical session will be held on Wednesday morning, and the two entertainment features scheduled for the remainder of the day will be a Mollala Buckaroo and an inspection of the country's largest heat pump installation.

On July 4, the day of the final events, a Buckaroo parade starting at 10:30 a.m., will be held, with the main events scheduled for the afternoon.

There will be a social hour, starting at 6:00 p.m., followed by the Semi-Annual Banquet which will conclude the City of Roses Meeting.

The Committee on Arrangements is highly encouraged by member interest in its film invitation to *Come to Portland*. Those who have viewed the film, and others who saw posters at the Annual Meeting, are making their plans. Many, who will drive from eastern cities, are studying highways for better routes and for scenic pleasures en route. For those preferring train travel, there are a variety of routes. Local ticket agents can give full information about the most desirable going routes and alternate return routes, depending on time available. There are numerous combinations that permit travel by northern, southern, or central routes and members may visit many of the National Parks en route to Portland or see them on the return trip. Other side trips that may be made are visits to Mexico, Hawaii, Alaska, or the Canadian Rockies.

Room Reservations

Hotel Multnomah

Suite — 2 Twin Bedrooms		$30.00
Suite — 2 Bedrooms — One Double & 1 Twin		35.00
Suite — 1 Bedroom		17.50
Deluxe Twins		10.00-12.00
Medium Twins		7.00- 9.00
Deluxe Doubles		10.00
Deluxe Twin & Double Connecting (3 Sets)		16.00
Twin & Double Connecting (10 Sets)		13.00
Doubles Connecting (5 Sets)		11.50
Doubles and Singles	Double	7.00
	Single	5.00

Indeed, both business and pleasure may be combined in a trip to the City of Roses Meeting. Some typical itineraries to Portland from Chapter Cities are given on these pages.

Some of the places that you may wish to see en route — whether you drive, go by train or plane — are Black Hills, Pikes Peak, Rocky Mountains, Estes, Yellowstone, Teton, Zion and Glacier Parks, Grand Canyon, Bryce Canyon, Feather River Canyon, Hoover Dam, Sun Valley, Crater Lake, Yosemite, Jasper Park and Canadian Rockies.

For those who wish to fly, Portland is served by United, Northwest, and Western Airlines. Various circle trips from southeastern and Canadian Cities may be arranged with local airline agents.

A special mailing will be made in April that will give full information about hotel rates and reservation forms, as well as additional details about the technical program. Later issues of the JOURNAL will keep members informed.

ROUND TRIP RAIL FARES TO PORTLAND, ORE.

VIA DIRECT ROUTES IN BOTH DIRECTIONS
(Fares in effect March 1, 1951)

From	Railroad Fare	Tax	Lower Berth (one way)	Tax
Atlanta, Ga.	$147.65	$22.15	$22.30	$3.35
Baltimore, Md.	176.35	26.45	24.30	3.65
Syracuse, N.Y.	169.30	25.40	23.10	3.47
Columbus, O.	141.70	21.26	20.80	3.12
Cincinnati, O.	134.15	20.12	20.25	3.04
New Haven, Conn.	190.17	28.53	25.15*	3.77
New Orleans, La.	138.90	20.84	21.95	3.29
San Francisco, Calif.	43.30	6.50	7.20	1.08
Chicago, Ill.	114.25	17.14	18.25	2.74
Indianapolis, Ind.	130.30	19.55	19.65	2.95
Spokane, Wash.	24.90	3.74	4.10	.62
Des Moines, Ia.	101.55	15.23	16.80	2.52
Kansas City, Mo.	95.70	14.36	15.75	2.36
Winnipeg, Man.	93.05	No tax	19.10†	No tax
Boston, Mass.	199.01	29.85	25.15	3.75
Memphis, Tenn.	123.15	18.47	18.85	2.83
Dayton, O.	137.65	20.65	20.80	3.12
Detroit, Mich.	139.25	20.89	20.25	3.04
Minneapolis, Minn.	95.70	14.36	15.75	2.36
Montreal, Que.	171.28	No tax	26.00	No tax
Omaha, Neb.	95.70	14.36	15.75	2.36
New York, N.Y.	187.85	28.18	25.15	3.77
Durham, N.C.	166.75	25.01	26.60	3.99
Dallas, Tex.	114.05	17.11	18.50	2.78
Tulsa, Okla.	106.75	16.01	19.25	2.89
Cleveland, O.	143.90	21.59	20.80	3.12
Oklahoma City, Okla.	107.10	16.07	19.55	2.93
Toronto, Ont.	147.33	No tax	23.30	No tax
Seattle, Wash.	10.70	1.61	3.50	.53
Philadelphia, Pa.	180.60	27.09	24.30	3.65
Pittsburgh, Pa.	154.10	23.12	21.70	3.26
Denver, Col.	76.45	11.47	12.85	1.93
St. Louis, Mo.	108.35	16.25	17.50	2.63
Shreveport, La.	123.70	18.56	20.25	3.04
Houston, Tex.	119.55	17.93	20.25	3.04
Los Angeles, Calif.	65.85	9.88	10.40	1.56
San Antonio, Tex.	119.55	17.93	20.00	3.00
Salt Lake City, Utah	51.65	7.75	8.65	1.30
Norfolk, Va.	166.95	25.04	25.15	3.77
Washington, D.C.	176.35	26.45	24.30	3.65
Grand Rapids, Mich.	130.93	19.64	21.75	3.26
Buffalo, N.Y.	158.35	23.75	22.30	3.35
Milwaukee, Wis.	112.80	16.92	18.25	2.74

*From New York
†Via Vancouver, B.C.

TYPICAL RAIL ROUTES TO PORTLAND, ORE.

B & O from New York
Philadelphia
Baltimore
Washington
Pittsburgh
Chicago

Burlington—Gt. Nor.—No. Pac. or Milw. Rd.
Milwaukee
Minneapolis-St. Paul
Spokane
Seattle
Portland

Burlington—D. & R. G.—U. P.
Houston
Dallas
Denver
Salt Lake City
Portland

New York Central from Boston
New York
Albany
Syracuse
Buffalo
Detroit
Cleveland
Chicago

Northwestern—U. P.
Rock Island—U. P.
Des Moines
Omaha
Denver
Salt Lake City
Portland

Rock Is.—D.& R. G.—W. Pac.—So. Pacific
Des Moines
Omaha
Denver
Salt Lake City
San Francisco
Portland

Pennsylvania from New York
Philadelphia
Baltimore
Washington
Pittsburgh
Columbus
Dayton
Cincinnati
Chicago

Santa Fe—So. Pacific
Kansas City
Witchita
Los Angeles
San Francisco
Portland

C. N.—C. P.—Gt. Nor.
Montreal
Toronto
Winnipeg
Seattle
Portland

TYPICAL AIR LINE RATES AND FLYING TIMES

City	One Way Rates*	Flying Time
Baltimore	$148.35	13 hr 5 min
Boston	166.55	15 hr
Chicago	113.75	7 hr 24 min
Cleveland	132.75	9 hr 38 min
Denver	65.00	4 hr 25 min
Des Moines	102.75	9 hr 25 min
Detroit	129.00	8 hr 54 min
Los Angeles	55.20	3 hr 20 min
Milwaukee	113.75	7 hr 14 min
New York	157.85	10 hr 59 min
Omaha	95.45	8 hr 25 min
Philadelphia	153.40	14 hr
Salt Lake City	41.55	2 hr 5 min
San Francisco	34.15	2 hr 30 min
Seattle-Tacoma	8.35	1 hr 20 min
Spokane	19.20	1 hr 25 min
Washington, D. C.	148.35	11 hr 30 min

*Add 15 percent federal tax.
5 percent discount on round trips.

Summary of Chapter Meetings

• *CENTRAL NEW YORK*—January 10, 1951. Pres. A. L. Jones called the meeting to order at 8:00 p.m. in Howard Johnson's Restaurant, Dewitt, N. Y., and the minutes of the October meeting were read and approved. Following the reading of the treasurer's report, H. K. Ormsby read a letter from A. V. Hutchinson, executive secretary of the Society, regarding an inquiry for engineers from C. B. Carter of the USN Civil Engineering Research.

The speaker of the evening, C. M. toeLaer of General Electric Co., Bloomfield, N. J., was introduced and spoke on *Present Trends in Warm Air Heating*, illustrating his talk with slides. Following the presentation, a question and answer period was conducted.

President Jones advised the members of the Society's action in waiving dues for members actively engaged in the armed services and it was moved that all members of the Central New York Chapter who are actively engaged in the armed services shall have Chapter dues waived during term of service. Attendance 56.

• *CINCINNATI*—January 15, 1951. In January the Cincinnati Chapter of ASHVE held a joint meeting with the *ASRE* with Garry Schultz acting as chairman. The business sessions of both groups were waived so that the full program could be completed.

Following dinner, Dean Joerger of the University of Cincinnati delighted the audience with his wit and wisdom in explaining the problems which confront the dean of an engineering college.

Dean Joerger introduced the speaker of the evening, Dr. C. A. Mills of the University of Cincinnati. Dr. Mills spoke on the operation of his home, *Reflection Point*, which embodies reflective cooling and heating principles. Dr. Mills gave a resume' of the temperatures encountered during the extreme cold weather and the operating hours of the equipment during this period. He emphasized that pressurizing the house had a lot to do in providing comfort conditions. During the extreme cold weather, the outside air admitted to the home was reduced from 300 cfm to 100 cfm, he stated. The talk was followed by an interesting question and answer period, after which the meeting adjourned.

• *DELTA*—January 20, 1951. The Delta Chapter of ASHVE met jointly with the New Orleans Section of the *ASRE* in conjunction with the Annual Meeting of the Louisiana Engineering Society in the Claiborne Room of the St. Charles Hotel.

The presiding officer at the meeting was Ralph Elizardi, president of the Delta Chapter of ASHVE, who introduced the speaker, C. V. Bankston, sales manager of Industries Sales Corp., New Orleans. Mr. Bankston discussed *Process Air Conditioning* and thoroughly covered the many applications of air conditioning in industry. Attendance 60.

• *DELTA*—January 9, 1951. The meeting was called to order in the Trophy Room of the New Orleans Athletic Club by Pres. Ralph Elizardi. Members and guests introduced themselves and the minutes of the November meeting were read and approved. President Elizardi read a special notice from A. V. Hutchinson, executive secretary, to the effect that dues were being waived for members of the Society on active duty in the armed services. President Elizardi paid tribute to all the past presidents of the Delta Chapter and informed R. B. Guest, Delta Chapter president for 1950, that his past president certificate would be presented at the next meeting.

A nominating committee was elected as follows: J. S. Burke, G. B. Gamble, C. S. Woodruff, R. B. Guest, and J. S. Adair; and the committee was told to report to the secretary 30 days prior to the May meeting.

R. K. Goode introduced the speaker of the evening, J. M. Shilstone, assistant director of Shilstone Testing Laboratories, Inc., who spoke on *Atomic Blast Effects*. The meeting was adjourned at 9:40 p.m. Attendance 37.

• *INDIANA*—January 26, 1951. Pres. C. F. A. Locke called the meeting to order at 7:00 p.m. in the Construction League Building and then gave a report on the Annual Meeting in Philadelphia. President Locke also announced that I. W. Cotton was elected to the Nominating Committee for the third region, that P. J. Marschall of Chicago had been elected as one of the alternates, and that Mr. Cotton had also been appointed chairman of the Committee on Research.

W. W. Grear, chairman of the meetings committee, introduced the members of the evening's forum as follows: C. Savage, F. Phelps, R. C. Blackman, A. C. Pfau, R. G. James, C. S. Roshaw, and R. H. Heilman. The members of the forum conducted a very interesting discussion on insulation, temperature regulation, air handling, and other phases of the industry. The meeting adjourned at 10:30 p.m. Attendance 38.

• *INLAND EMPIRE*—January 5, 1951. Members and guests met at 8:30 p.m. in the Grill Room of the Spokane Hotel and Pres. W. C. Vradenburg called the meeting to order. The minutes of the previous meeting were read and approved and reports were made by the membership, publicity, and program committees, and also by the treasurer. J. E. Hutsinpiller and J. C. Kelly were elected as member and alternate member for the Inland Empire Chapter on the Chapters Conference Committee.

The meeting was then turned over to L. E. Marque, who conducted a

discussion on *Engineers, Contractors, and Suppliers.* This was followed by a brief discussion on features for the next Chapter meeting. The meeting adjourned at 10:30 p.m. Attendance 23.

• *IOWA*—January 16, 1951. Pres. R. S. Stover called the meeting to order at 8:00 p.m. at the Standard Club, Des Moines, which was followed by the roll call of members and the introduction of guests. Professor Kerekes, chairman of the Uniform Building Code Committee, gave an outline of the past activities of the Committee in attempting to secure passage of the Code and the path to be followed in the future in continuing activities in this direction. Professor Kerekes invited the cooperation of the Iowa Chapter in working with the Code Committee.

The program for the evening consisted of an open forum discussion on the unification of specifications. The first section of the forum on air conditioning contractors' problems in reference to plans and the obtaining of materials was discussed by W. E. Hainline.

B. A. Schwirtz discussed the problems of the equipment supplier, while W. E. Nanes spoke concerning the problems of the engineering consultant. An interesting question and answer period followed with D. C. Murphy acting as moderator. The meeting adjourned at 10:00 p.m. Attendance 31.

• *KANSAS CITY*—February 5, 1951. Members and guests met in the Roof Garden of the Aladdin Hotel, Kansas City, Mo., for a joint meeting with the *ASRE*, and Pres. W. E. Howarth presided. E. L. Smith reported on the Technical Societies Council, mentioning its activities and indicating that progress is being made. He stated that questionnaires are being sent to engineers in Kansas City to fit them into the Civil Defense Program. C. W. Schumacher reported on the activities at the Annual Meeting in Philadelphia and moved that D. M. Allen be extended a vote of thanks for his excellent work as a member of the Society's Council for the past three years. President Howarth then introduced Henry Schmall, vice president of the *ASRE* Section.

The meeting was then turned over to Mr. Schumacher, the program chairman, who introduced C. G. Roush. Mr. Roush spoke on *Engineers* and began by defining the term *engineer.* He stated that February 18-24 had been proclaimed National Engineers Week and that radio programs and talks to Civic Clubs would be held during this week. He concluded by stating that the purpose of Engineers Week is to impress the public with engineering as a profession.

V. D. Wissmiller, supervisor, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., was introduced as the speaker of the evening by Mr. Schumacher. Mr. Wissmiller spoke on the development of radio, television, and radar. He discussed electronic calculators, pilotless planes, weather forecasts, vacuum tubes and various types of electronic thermostats. He explained the operation of the electronic thermostat, the measurement of relative humidity utilizing a grid of gold wire coated with hygroscopic material, domestic electronic controls, odor detection, etc. Attendance 69.

• *MEMPHIS*—January 15, 1951. Following dinner, Pres. C. S. Fischer called the meeting to order at 7:55 p.m. in the King Cotton Hotel and the minutes of the November and December meetings were read and approved.

The meeting was then turned over to R. E. Larkin, chairman of the meetings committee, who introduced the speaker of the evening, Dean Eggert of the service information division of White-Rodgers Electric Co. Mr. Eggert spoke generally on the subject of electric controls for heating and air conditioning application. He made it quite clear that a competent service organization, properly staffed and well trained in the installation and servicing of controls, was important today. He pointed out that engineers do the job initially; competent control service men back up the engineer. After a question and answer period, Mr. Eggert was thanked by President Fischer on behalf of the Chapter. The meeting adjourned at 10:00 p.m. Attendance 28.

• *MINNESOTA*—February 7, 1951. The meeting was called to order in the Garden Room of The Dyckman Hotel, Minneapolis, by Pres. G. M. Kendrick, who then introduced the guests of the evening. The minutes of the December and January meetings were read and approved. President Kendrick spoke briefly on the Annual Meeting in Philadelphia and reported that 17 Minnesota Chapter members had attended the Meeting. A nominating committee was elected as follows: W. W. Martenis, B. J. Mulcahy, William McNamara, E. A. Johnson, and L. C. Gross; and the committee was told to report to the secretary prior to the March meeting.

President Kendrick introduced the speaker of the evening, John W. James, chief research engineer, McDonnell & Miller, Inc., Chicago, Ill., who presented an excellent talk on *Hot Water Heating.* The talk was followed by a question and answer period. The meeting adjourned at 9:50 p.m. Attendance 118. Attendance ratio 0.34*.

• *OKLAHOMA*—February 12, 1951. Pres. R. E. Swan called the meeting to order at 8:30 p.m. in Beverly's Drive-In and asked that all membership application blanks be sent to the chapter secretary, who would transmit them to the Society headquarters in New York.

The speaker of the evening was J. R. Vernon, secretary, Johnson Service Co., Milwaukee, Wis., who spoke on *Recent Developments in Automatic Temperature Control for Heating and Air Conditioning.* Mr. Vernon discussed briefly the control industry

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

in general, dividing it into three sections: (1) package controls (2) control systems and (3) industrial controllers. He then gave an illustrated lecture on control systems and discussed the characteristics of modern automatic temperature and humidity control equipment and the application of that equipment to various types of buildings. The meeting adjourned at 10:15 p.m. Attendance 54. Attendance ratio 0.37.

• *ONTARIO*—February 7, 1951. Pres. J. H. Fox called the meeting to order at 7:00 p.m. following dinner in the Royal York Hotel. William Philip, Ontario Chapter representative on the Chapters Conference Committee, reported on the recent Annual Meeting in Philadelphia. President Fox announced that the March meeting would feature a panel discussion on the subject of *Low Cost Housing.*

The speaker of the evening was G. Lorne Wiggs, of Wiggs, Walford, Frost & Lindsay, Montreal. Mr. Wiggs spoke on *Radiant Heating and Cooling* and illustrated his address with slides. The talk was very well received and resulted in an interesting and enthusiastic discussion period at the end of the presentation. Attendance 132. Attendance ratio 0.40.

• *OREGON*—January 4, 1951. The meeting was called to order at 7:30 p.m. in the Old Heathman Hotel by Pres. R. C. Chewning and the minutes of the December meeting were read and approved. This was followed by the treasurer's report and a report by the membership committee. B. W. Farnes, general chairman of the Committee on Arrangements for the 1951 Semi-Annual Meeting, reported on plans for promoting attendance at the Semi-Annual Meeting by advertising the coming Portland Meeting at the Annual Meeting in Philadelphia. A period of discussion on Chapter business followed, and a nominating committee was elected as follows: C. W. Brissenden, *chairman,* W. B. Morrison, J. P. McDermott, J. D. Kroeker, and E. R. Lokey.

Mr. Kroeker introduced the speaker of the evening, Charles Quentel, who presented a film *Steam for Power* and in the discussion period which followed answered many questions from the audience. The meeting adjourned at 10:21 p.m.

• *PHILADELPHIA*—February 8, 1951. Pres. J. W. McElgin was the presiding officer and called the meeting to order at 7:30 p.m. in the Engineers Club. The minutes of the previous meeting and the treasurer's report were read and approved.

The speaker of the evening was R. D. Tutt, chief engineer, Tuttle & Bailey, Inc., New Britain, Conn., who spoke on the subject, *Modern Trends in Air Distribution.* The talk was interesting and well presented and Mr. Tutt used slides to illustrate the talk. The meeting adjourned at 9:25 p.m. Attendance 95. Attendance ratio 0.33.

• *ROCKY MOUNTAIN*—January 3, 1951. Pres. R. W. Petersen called the meeting to order at 8:00 p.m. in the Silver Wing Inn, Englewood, Colo., and following the roll call of members, the guests were introduced. The minutes of the previous meeting were read and approved and reports were given by the code and attendance committees.

The speaker of the evening was Prof. George Lof, Ph.D., School of Industrial Research, University of Denver, who spoke on the subject *Use of Solar Energy in Heating and Air Conditioning.* Dr. Lof renewed his pleasant association with the Rocky Mountain Chapter and reviewed basic research on solar collection and, in addition, brought the group up to date on the various research projects using solar energy for heating and air conditioning. Dr. Lof emphasized that solar collectors should generally be considered as supplements to other forms of heat energy to perform a heating function in most sections of the United States. He also pointed out that the unit cost of conventional fuels within close limits will determine whether or not a solar energy system is economical. Dr. Lof's discussion was an excellent blend of technical discussion and practical demonstration, including the use of a model of a solar heated residence. The meeting adjourned at 9:45 p.m. Attendance 63. Attendance ratio 0.50.

• *ST. LOUIS*—January 9, 1951. Pres. J. S. Rosebrough called the meeting to order at 7:30 p.m. in Town Hall. The minutes of the December meeting were read and approved and the treasurer made a brief report. This was followed by the discussion of a few items of chapter business.

The meeting was adjourned at 7:45 p.m. and reconvened at 8:00 p.m. at which time F. E. Ince, sales application and research engineer, Marlo Coil Co., St. Louis, presented a talk with slides showing the construction and design of cooling towers and evaporative condensers and gave the advantages and disadvantages of each. The meeting adjourned at 9:15 p.m. Attendance 46.

• *SHREVEPORT*—January 18, 1951. Pres. S. W. Beaty called the meeting to order and the treasurer made a brief report. President Beaty discussed a number of business items and commended L. C. Haas, the publicity chairman, for the excellent job he was doing in that capacity. A movie on the City of Roses Meeting, which was made available through the Oregon Chapter in order to promote attendance at the 1951 Semi-Annual Meeting in Portland, was shown.

M. A. Hudson introduced the speaker of the evening, Thomas Landurum, who spoke on the *Status of Air Conditioning Equipment for 1951.*

• *SOUTH TEXAS*—January 12, 1951. The meeting was called to order at 8:00 p.m. by Pres. H. W. Broadwell, who asked for discussion regarding a meeting place. The reading of minutes was dispensed with since the December meeting had been a Christmas Party. E. G. Floeter, Jr., reported on the condition of chapter finances, stating that the

financial status of the South Texas Chapter was sound. J. C. Lewis and J. N. Powell made reports for the membership and attendance committees, respectively, and President Broadwell read the research committee report.

J. W. Holland, program chairman, introduced the speaker, Arlie Baker, of Alco Valve Co. Mr. Baker spoke on the operation of a refrigeration system, highlighting the part played by the various control valves in the system. He showed, with the use of films, slides and a glass working model, how various valves and control devices might best be utilized for refrigeration installations. Mr. Baker's talk was received with interest and the question and answer period was lively and stimulating. The meeting adjourned at 10:30 p.m. Attendance 79.

• *SOUTHWEST TEXAS*—January 16, 1951. Pres. I. W. Wilke called the meeting to order in the Cascade Room of the St. Anthony Hotel, San Antonio, Tex. at 8:30 p.m. The minutes of the previous meeting were read and approved. President Wilke announced the following committee appointments for the year 1951: *legislative and code*—L. S. Pawkett, *chairman;* M. E. Staley, A. T. Moses, and D. E. Locher; *program*—W. E. Long, *chairman*, L. H. Hornor, Jr., and B. F. McCary; *membership*—J. G. Hopping, Jr., *chairman*, L. N. Mathis, and M. K. Witt.

Mr. Pawkett introduced the speaker of the evening, Herman Blum, consulting engineer of Dallas, who gave an interesting talk on *High Pressure Air Distribution Systems.* Mr. Blum discussed the problems involved in the proper air distribution in large buildings of multi-zones with varying exposures. The meeting adjourned at 10:00 p.m. Attendance 29. Attendance ratio 0.48.

• *VIRGINIA*—January 17, 1951. The meeting was called to order by Pres. W. P. Robinson at 8:15 p.m. in the auditorium of R. F. Trant Co. and the minutes of the previous meeting were read and approved. D. E. Phillips read the report of the board of governors for 1950 and copies of the report were distributed to the members. The following officers were elected for the year 1951-52: *president*—J. F. Boyenton; *vice president*—D. E. Phillips; *secretary-treasurer*—J. E. Harding; and *board of governors*—J. F. Reynolds and F. R. Ervin. Mr. Ervin was elected to serve as the Virginia Chapter representative on the Chapters Conference Committee.

A movie entitled *Frozen Freshness*, concerning the preparation and results obtained in freezing various foods, was shown. Mr. Robinson then turned the meeting over to Mr. Boyenton, the new chapter president. Mr. Boyenton requested the cooperation of all the members in getting the year off to a good start and proposed a concentrated effort to build up the Chapter membership. To further the effort, he suggested that the February meeting be a dinner meeting. Mr. Phillips then presented Mr. Robinson with a past president's pin. Attendance 14. Attendance ratio 0.64.

• *WESTERN MICHIGAN*—January 8, 1951. Following dinner, the business meeting was called to order at 7:35 p.m. in the Elks Temple, Battle Creek, by Pres. K. E. Robinson. President Robinson announced the death of L. A. Calcaterra and stated that flowers had been sent on behalf of the Chapter. It was also announced that a new chapter called the Empire State Capital Chapter would hold its charter meeting on January 15 and President Robinson was asked to send a wire of congratulations.

The meeting was turned over to Prof. C. H. Pesterfield, who introduced Dr. A. J. Smith, of Michigan State College, who spoke on *Corrosion of Steel*, particularly discussing corrosion caused by elevated temperatures and products of combustion. Dr. Smith's talk covered such subjects as the problems of water corrosion in cooling systems where ground water is used, and also water corrosion problems as encountered in condensate return systems. He also discussed high temperature corrosion in furnaces, stress corrosion, and corrosion on the water side of heating boilers. A lively discussion period followed Dr. Smith's talk in which many additional subjects were also discussed. The meeting adjourned at 9:45 p.m. Attendance 44.

OBITUARY

THOMAS M. DUGAN
McKeesport, Pa.

T. M. Dugan, a Life Member of the Society, died on January 9, 1950. Mr. Dugan was born on July 1, 1879 at Oil City, Pa., where he attended school.

At the beginning of his career, Mr. Dugan went into business for himself, designing and installing heating systems at Pitcairn, Pa. Mr. Dugan then became associated with the National Tube Co. of McKeesport, where he remained employed for the greater part of his business career, serving as master plumber until 1927. He was made heating and ventilating engineer in 1928, which position he held until 1934 when he became sanitary and heating engineer. Mr. Dugan terminated his association with the National Tube Co. in 1945 and at the time of his death was the executive secretary of the *American Society of Sanitary Engineering*, which position he had held for several years.

Mr. Dugan was a past president of the Pittsburgh Chapter of ASHVE, and was the ASHVE representative on the *ASA* Sectional Committee on American Standards for Pipe Threads and on the *ASA* Sectional Committee on Standardization of Pipe Flanges and Fittings for many years. He was secretary of the *Mon-Youg Master Plumbers' Association* and Grand Knight, McKeesport Council 955, Knights of Columbus, McKeesport Assembly, Fourth Degree.

The Officers and Council of the Society extend their sincere sympathy to the members of Mr. Dugan's family.

Candidates for Membership

The Society's By-Laws require that all applications for membership or advancement are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society, or mailed to all members. When the replies are received from references the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall confirm the election of the proposed Candidate for membership. During the past month 89 applications for membership, including 33 student applications, 3 reinstatements; and 14 advancements have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by March 30, 1951, these candidates will be voted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

BEAR, R. K., Commercial Sales Mgr., Kansas Gas Electric Co., Wichita, Kan. REFERENCES: R. F. Bauer, B. L. Blackburn, E. G. Fahnestock, S. F. Whitley.

BENTON, MAURICE, Sr. Designer, Devenco Inc., New York, N.Y. REFERENCES: J. S. Brown, J. T. Falk, S. O. Hess, B. B. Howes.

BIRO, J. E., Sales Engr., John Lloyd & Sons, Allentown, Pa. REFERENCES: N. J. Handman, G. W. Hersh, Jr., C. B. Korn, D. B. Macdonald.

BONUS, W. H., Asst. Superintendent, Engineering and Development, University of Toronto, Toronto, Ont., Canada. REFERENCES: H. H. Angus, J. H. Fox, T. R. Loudon*, T. M. Medland*.

BRANSON, R. J., Pres., B & B Air Cooling & Heating Service, Inc., Wichita, Kan. REFERENCES: E. E. Barr, R. F. Bauer, E. C. Blood, Lynn Johnson*.

BROWNING, W. S., Sales Mgr., C. A. Dunham Co., Chicago, Ill. REFERENCES: C. M. Burnam, Jr., J. O. Kirkbride, O. J. Prentice, F. E. Schmidt.

BURNS, L. W., Engr., Multi-Vent Div., Pyle-National Co., Chicago, Ill. REFERENCES: W. F. Botensten, E. J. Kurek, G. K. Raider, A. R. Wallace*.

CLARK, V. F., Vice Pres. & Treas., Air-Aid Corp., New York, N.Y. REFERENCES: C. F. Brooks*, W. E. Howell*, Irving Langmuir*, V. J. Shaefer*.

DERYCKE, A. R., Asst. Mgr., Kewanee Boiler Corp., Minneapolis, Minn. REFERENCES: H. E. Gerrish, G. M. Kendrick, L. K. Reisberg, William Sturm.

DEWANZ, A. C., Partner, Dewanz Plumbing & Heating Co., Blue Earth, Minn. REFERENCES: G. M. Orr, H. P. Roberts, R. H. Lindgren, J. R. Younger.

FOWLER, F. L., Sales Engr., Minneapolis-Honeywell Regulator Co., Seattle, Wash. REFERENCES: K. H. Hanson, R. D. Hoss, D. C. Griffin, F. W. McCarthy.

GLYNN, M. J., Chief Mechanical Inspector, Harley, Ellington and Day, Inc., Detroit, Mich. REFERENCES: R. L. Getts, R. M. McIntosh, Garni Moretti, H. P. Osgood.

GORSKY, M. H., Sales Mgr., The Premier Vacuum Cleaner Co., Ltd. Toronto, Ont., Canada. REFERENCES: G. P. Cooper, W. H. Evans, N. W. Kingsland, A. E. McGruer.

HAINES, H. A., Heating Engr., Lehigh Valley Supply Co., Allentown, Pa. REFERENCES: M. F. Blankin, C. F. Dietz, H. H. Erickson, A. E. Kriebel.

HELENSKI, L. W., Application Engr. William J. Carson, Cons. Engr., West Hartford, Conn. REFERENCES: W. J. Carson*, L. O. R. Clark, E. R. Clement, P. J. Lamoureux.

HICKE, G. E., Mgr., Transportation and Marine Div., The Trane Co., La Crosse, Wis. REFERENCES: John Everetts, Jr., William Goodman, William McNamara, N. H. Peterson.

HIDALGO, CARLOS, Student Engr., International Div., Carrier Corp., New York, N.Y. REFERENCES: George Burt*, J. H. Carpenter, Neal Clemmer*, Americo Silvera.

HORNE, B. E., Sales Engr., Wm. E. Kingswell, Inc., Washington, D.C. REFERENCES: W. E. Kingswell, B. L. Nye, Jr., L. Ourusoff, F. M. Thuney.

HOSHAW, C. L., Indianapolis Contract Mgr., The Philip Carey Mfg. Co., Indianapolis, Ind. REFERENCES: Sidney Fenstermaker, Jr., W. W. Green, J. T. Hardin, R. J. Illingworth.

HUNT, EDWIN, Sales Engr., Brod & McClung, Portland, Ore. REFERENCES: Dick Blankenship, H. W. MacKenzie, T. H. McClung, T. E. Taylor.

JEWELL, B. W., Vice Pres. and Chief Engr., The O. A. Sutton Corp., Wichita, Kan. REFERENCES: J. M. Gruitch, W. W. Higham*, Charles Neeson*, Lloyd Stabler*.

JOHNSON, G. L., Owner, Johnson Service Co., Hannibal, Mo. REFERENCES: C. A. Durphy, W. J. Oonk, H. C. Sharp, P. C. Strauch.

JOHNSON, J. P., Chief Engr., Vent. Div., The Swartwout Co., Cleveland, Ohio. REFERENCES: E. H. Cox, J. P. Maguire, E. H. Taze, J. M. Witheridge.

KELLER, A. P. H., Engr., Gausman & Moore, Cons. Engrs., St. Paul, Minn. REFERENCES: C. E. Gausman, G. F. Gausman, J. R. Peterson, William Sturm.

KILROY, F. M., Engr., Kilroy Co. Inc., Louisville, Ky. REFERENCES: Merl Baker, W. M. Carter*, O. W. Gard*, W. F. Savage*.

KRESS, D. E., Owner, Kress Engineering & Sales Co., Grand Rapids, Mich. REFERENCES: V. C. Dean, R. W. Mangrum, B. J. Walter, F. C. Warren.

LEMPICKI, TADEUSZ, Plant Mgr., AGA Steel Radiators of Canada, Ltd., Ajax, Ont., Canada. REFERENCES: D. L. Angus, A. M. Clark, R. L. Elsie, D. I. Paul.

LYNCH, D. A., Mgr., Educational Dept., The Lennox Furnace Co., Columbus, Ohio. REFERENCES: A. D. Bogen, H. G. Hays, N. T. Hess, R. J. Schmitz, Jr.

MERCURIO, S. P., JR., Designer, Griffiss Air Force Base, Rome, N.Y. REFERENCES: F. W. Chadwick, Felix Laine, J. W. Stevens, G. A. Warner.

MILLER, J. E., Sales Mgr., A-J. Manufacturing Co., Kansas City, Mo. REFERENCES: D. M. Allen, L. A. Heaven, A. S. Hurt, Jr., H. H. Lewis.

MORELL, R. H., Draftsman & Designer, Thomas Robertson & Co., Montreal, Que., Canada. REFERENCES: G. E. Perras, G. H. Powell, J. D. Ross, W. W. Timmins.

MOROH, SIGMOND, Sales Engr., The National Radiator Co., Johnstown, Pa. REFERENCES: C. M. Baumgardner, W. L. Fleisher, L. N. Hunter, E. R. Queer.

MULL, D. J., Asst. Chief Engr., The O. A. Sutton Corp., Wichita, Kan. REFERENCES: D. S. Falk, H. E. Keeler*, R. H. McGeorge, F. W. McMillan*.

NATKIN, B. M., Direct Sales Repr., General Electric Co., New York, N.Y. REFERENCES: R. U. Berry, F. H. Faust, R. K. Raisler, E. A. Rapp.

NORTH, ROWLAND, Sales Engr., J. F. Crowley Ltd., Dundas, Ont., Canada. REFERENCES: W. J. Coates, Arthur Nearingburg, W. D. Sheldon, Jr., Raul Roy.

PANLENER, R. A., Heating Engr., J. H. Fagan Co., Milwaukee, Wis., REFERENCES: B. M. Kluge, R. G. Koch, L. C. Plaehn, O. J. Ress.

*Non-Member

JOURNAL SECTION

PARKES, R. J., Sr. Sales & Design Engr., Speedway Products Ltd., Auckland, New Zealand. REFERENCES: E. M. Taylor, L. F. Taylor, H. W. J. Lipscombe, H. A. L. Vale.

PARKS, G. E., Engr., A. H. & P. Co., Inc., Chicago, Ill., REFERENCES: H. J. Couch, H. G. Gragg, J. J. Hayes, A. O. May.

PENNINGTON, R. L., Sales Mgr., U. S. Supply Co., Wichita, Kan. REFERENCES: A. R. Barnes, R. F. Bauer, O. P. Bullock, E. G. Fahnestock.

POL, W. I., Mgr., Airtrol Engineering Co., Baton Rouge, La. REFERENCES: J. S. Adair, R. K. Goode, W. G. Moses, C. S. Woodruff.

ROBB, E. D., Owner-Pres., E. D. Robb, Contractor, Toronto, Ont., Canada. REFERENCES: R. P. Allsop, Ernest Fox, J. H. Ross, H. R. Roth.

ROBBINS, R. C., Mgr., Plan Service Dept., Lennox Furnace Co., Columbus, Ohio. REFERENCES: A. D. Bogen, H. G. Hays, N. T. Hess, R. J. Schmitz, Jr.

SCARSELLETTA, A. L., Sales Engr., Capitol Plumbing & Heating, Albany, N. Y. REFERENCES: J. N. Futia, F. G. Gavaletz, Harry Horowitz, E. K. Smythe.

SMITH, L. L., Chief Engr., Air Cond. Dept., American Radiator & Standard Sanitary Corp., Yonkers, N. Y. REFERENCES: R. J. Ditto*, F. E. Hanson, J. B. Uhl*, Herwart Werker.

SOBOLEWSKI, E. A., Chief Engr., Floyd & Co., Cincinnati, Ohio. REFERENCES: B. R. Byard, I. G. Edwards, H. W. Moore, H. E. Russel.

SPEARS, J. F., Branch Mgr., The Trane Co., Chattanooga, Tenn. REFERENCES: G. S. Campbell, A. W. Edwards, C. A. Spears, Jr., N. H. Peterson.

STRIBLING, J. W., Application Engr., Sales Div., General Electric Co., Bloomfield, N. J. REFERENCES: R. U. Berry, F. H. Faust, W. P. R. Karsten*, E. A. Rapp.

TESAR, R. J., Sales Repr., Taco Heaters, Inc., Portland, Conn. REFERENCES: E. T. Houlihan, T. F. Houlihan, W. A. Johnson, R. T. Schoerner.

toeLAER, C. M., Application Engr., General Electric Co., Bloomfield, N. J. REFERENCES: C. W. Brown, F. H. Faust, G. K. Marshall, E. A. Rapp.

TRICKLER, C. J., Research Engr., New York Blower Co., La Porte, Ind. REFERENCES: J. W. Mathis, S. F. Rost, J. H. Shrock, E. E. Trickler.

VIELE, M. R., Engrg. Draftsman, Douglas Aircraft Co., Long Beach, Calif. REFERENCES: M. C. Greiner, A. J. Hess, R. F. Pyle, W. F. Walker.

vonBEHREN, F. W., Engr., Henry Adams, Inc., Baltimore, Md., REFERENCES: E. L. Crosby, R. E. Dressell, G. B. Priester, W. G. Robertson, Jr.

WOODSON, J. C., JR., Commercial Engr., General Electric Co., Bloomfield, N. J. REFERENCES: F. H. Faust, W. F. R. Karsten*, G. K. Marshall, E. A. Rapp.

WRASSMAN, O. B., Sales Mgr., Aramac Supply Co., Cincinnati, Ohio. REFERENCES: J. J. Bechtol, R. J. Clark, F. B. DeBra, H. C. Smith.

*Non-Member

STUDENTS

COLLEGE OF THE CITY OF NEW YORK, New York, N. Y. CERTIFIED BY: A. V. Repetto.
BLEIWEISS, M. N.
KARSCH, O. A.

NORTH CAROLINA STATE COLLEGE, Raleigh, N. C. CERTIFIED BY: T. C. Brown.
LATHERS, F. T.
SHINN, W. H.

OKLAHOMA A. & M. COLLEGE, Stillwater, Okla. CERTIFIED BY: R. R. Irwin*.
GROUND, P. L.

OREGON STATE COLLEGE, Corvallis, Ore. CERTIFIED BY: W. C. Baker.
CRUSON, C. R.
LUCAS, A. E.
STONE, E. L.
WAGNER, J. J.

UNIVERSITY OF DETROIT, Detroit, Mich. CERTIFIED BY: Joachim Lay.*
BACZYNSKI, R. C.
CAMERON, D. J.
DICKERSON, R. E.
DRAKE, R. H.
DRUZYNSKI, F. C.
DUBY, A. J.
ERICKSON, R. W.
FEAHENY, T. J. JR.
KEARNS, R. W.
KELLMAN, GEORGE
KLOF, JOHN
MAYERNIK, R. J.
MELNYK, WILLIAM
PAUL, D. S.
PAWLOWSKI, P. E.
SANCTORUM, G. E.
SCHIRMER, W. J.
SCHULENBERG, G. S.
WOLF, H. K.

UNIVERSITY OF ILLINOIS, Urbana, Ill. CERTIFIED BY: J. R. Carroll, Jr.
ANDERSON, W. A.
BORCHERDING, R. M.

UNIVERSITY OF ILLINOIS, Urbana, Ill. CERTIFIED BY: J. R. Fellows.
MOORE, R. P.

UNIVERSITY OF ILLINOIS, Urbana, Ill. CERTIFIED BY: S. Konzo.
LEA, J. S.
SADLER, G. W.

REINSTATEMENTS

HUGGINS, L. G., Product Planner, General Electric Co., Bloomfield, N. J. REFERENCES: R. U. Berry, F. H. Faust, A. H. Goelz, P. J. Marschall.

TIGNOR, W. L., Mgr., Heating Dept., Hagan Supply Corp., Norfolk, Va. REFERENCES: G. W. Dailey*, V. B. Harris*, T. H. Webb, Jr.*, L. T. Zoby*.

ADVANCEMENTS

ALLEN, A. G., Jr. Engr., Forney Engineering Co., Dallas, Tex. REFERENCES: J. P. Ashcraft, C. R. Gardner, G. A. Linskie, W. E. Long.

BEATY, S. W., Air Conditioning Engr., Ark. Natural Gas Corp., Shreveport, La. REFERENCES: Walter Cooke, R. M. Hood, D. M. Mills, I. W. Wilke.

BYARS, W. A., JR., Sales Engr., Airtex, Inc., Houston, Tex. REFERENCES: Philip Kalman, W. L. Lashley, Jr., J. C. Lewis, J. N. Powell.

CURTIS, S. R., Research Engr., Duo-Therm Div. of Motor Wheel Corp., Lansing, Mich. REFERENCES: L. G. Miller, C. H. Pesterfield, K. E. Robinson, R. J. Waalkes.

DAVIS, E. A., Heating Engr., Mehring & Hanson Co., Chicago, Ill. REFERENCES: M. W. Bishop, J. E. McClellan, J. J. Philippi, R. B. Smith.

DUDLEY, J. G. III, Heating and Air Cond. Sales Engr., J. C. Dudley, Jr., Shelby, N. C. REFERENCES: T. C. Brown, Kirkpatrick Cousart, W. L. Jewell*, C. A. McKeeman.

HAWLEY, C. D., Designer, Natkin & Co., Kansas City, Mo. REFERENCES: D. M. Allen, J. G. Barnes, Jr., H. E. Gould, E. E. Ralston.

HUMPHREY, L. G., JR., Asst. to Mgr., Federal & Marine Dept., Buffalo Forge Co., Buffalo Pumps, Inc., Washington, D. C. REFERENCES: I. M. Day, L. T. Davis, J. W. Markert, W. C. Reamy, Jr.

IVERSTROM, CARL, Washington Repr., Edward E. Ashley, Cons. Engr., Washington, D. C. REFERENCES: Albert Giannini, J. B. Hewett, H. G. Junger, S. A. Spencer.

LLOYD, R. T., JR., Jr. Engr., York Corp., Charlotte, N. C. REFERENCES: T. C. Brown, J. S. Doolittle*, S. G. Flannagan, D. P. Schiwetz.

MANN, L. B., Vice Pres., Boston Filter Co., Inc., Boston, Mass. REFERENCES: D. W. Blair, E. G. Carrier, A. L. Hesselschwerdt, Jr., A. E. Stacey, Jr.

MINAKER, M. E., Branch Mgr., Minneapolis-Honeywell Regulator Co., Ltd., Vancouver, B. C., Canada. REFERENCES: J. H. Fox, R. D. Hale, V. J. Jenkinson, C. W. Leek.

SZEKELY, G. E., Application Engr., Bayley Blower Co., Milwaukee, Wis. REFERENCES: B. M. Kluge, A. S. Krenz, C. H. Randolph, Ernest Szekely.

WESSELS, WILLIAM, Cadet Engr., Michigan Consolidated Gas Co., Grand Rapids, Mich. REFERENCES: V. C. Dean, S. M. Paganelli, F. C. Warren, H. F. Wilson.

WILLIAMS, K. O., Direct Factory Repr., H. A. Thrush & Co., Peru, Ind. REFERENCES: G. H. Bemarkt, P. X. Bergeron, J. F. Naylor, Jr., G. B. Rodenheiser.

Research is Translated for Engineering Application

When you receive your copy of THE GUIDE 1951, you may take a quick glance through the preface and the table of contents to see what new features have been included, or you may turn to a special chapter because of your interest in some particular subject.

If, as part of your daily work, you are concerned with the determination of cooling loads, then turn to Chapter 12. Here you will find a great deal of new information, most of which has been developed as the result of Society research.

Early in 1945, the Committee on Research decided to make a comprehensive experimental investigation of solar radiation transmission through glass. This step was taken because a careful study of the information then available had shown that much was lacking, and that some of the data available were contradictory. Here, then, was almost a perfect setting for a soundly planned and carefully executed program of basic research. Special equipment was designed and constructed at the Laboratory, and over the past five years nine research papers and two research bulletins have been published giving the results from the analytical and experimental investigations carried on under the general direction of the Technical Advisory Committee on Heat Flow Through Glass (R. A. Miller, chairman).

Even when these data became available, there was something still lacking. That something was the translation of the Laboratory data into usable design data, set up in such a form that the engineer could quickly pick out the values he needed in his calculations of the effect of solar radiation transmission on cooling load requirements. A paper presented at the Semi-Annual Meeting 1950 set the pattern for this type of information. The Guide Committee then enlisted the help of the Research staff to prepare a new Chapter on Cooling Load, incorporating the available information on solar heat gain through unshaded glass.

This is not the end of the story. The staff are now making analytical and experimental studies of the effects of shading on solar heat transmission so that eventually this information will be added to the Chapter on Cooling Load. They are also preparing another research bulletin that will give, in greater detail than is possible in research papers, the complete results from the Laboratory studies.

Heat Storage

Even when all this has been done there still will remain the difficult problem of translating instantaneous heat gain into cooling load. A new Technical Advisory Committee on Heat Storage is being set up to coordinate the viewpoints of all the other Technical Advisory Committees interested in this complex problem. Preliminary steps are being taken to investigate the practicability of extensive tests by means of electrical or hydraulic analogues.

When this is completed, still another frontier will have been crossed in the search for new knowledge and more accurate information for the use of the Society membership.

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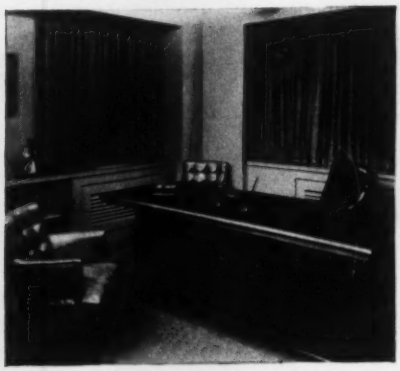

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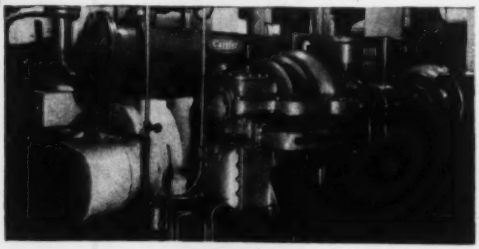

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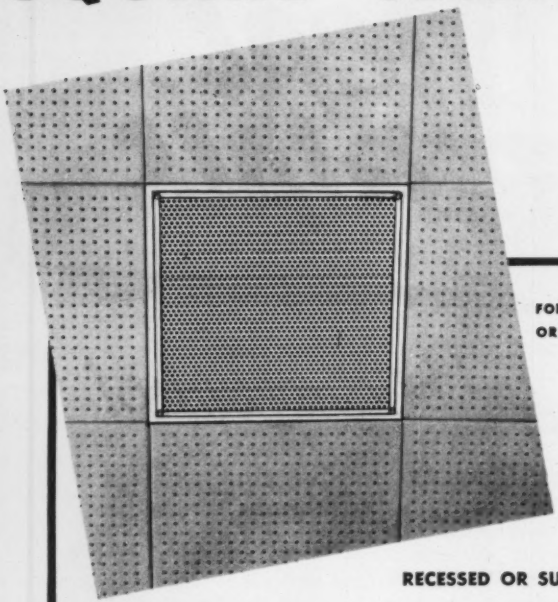
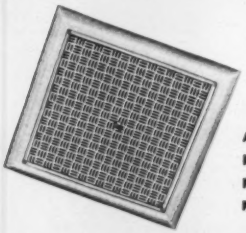
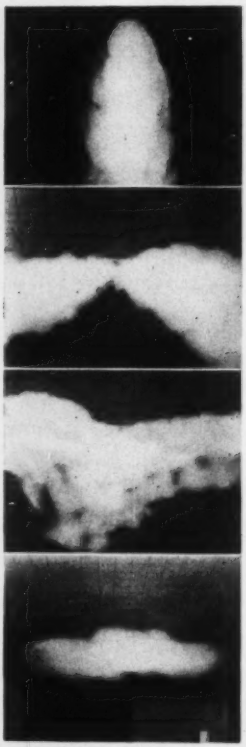


RECESSED OR SURFACE TYPES



AVAILABLE IN SEVERAL PERFORATION PATTERNS

FOR ACOUSTICAL TILE OR PLASTER CEILING



ADJUSTS TO ANY DISTRIBUTION REQUIREMENT

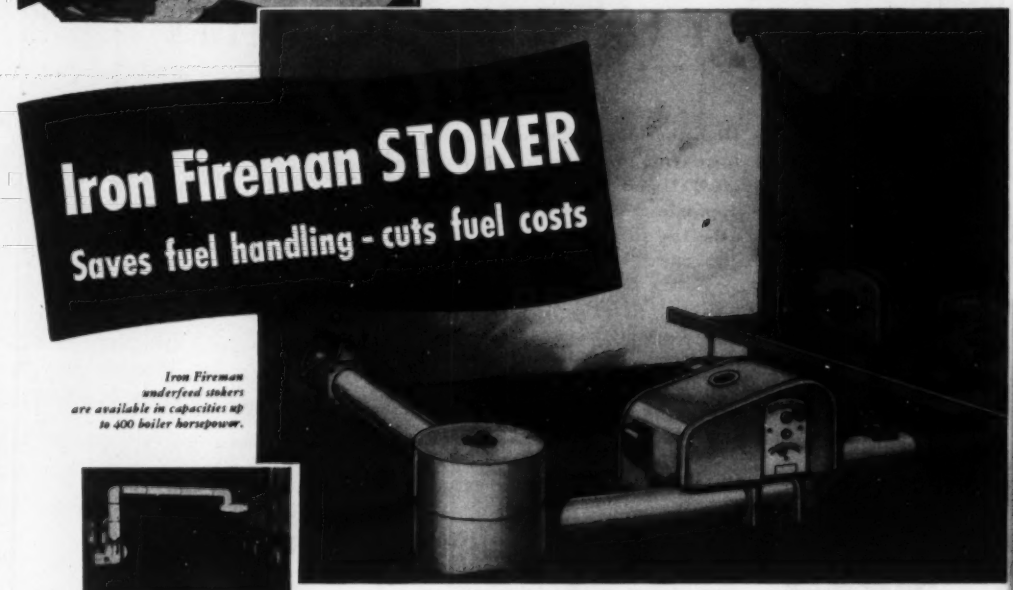
UNI-FLO Square Ceiling Outlets are adjustable *on the job and after installation* to discharge air in one, two, three, or four directions and provide air patterns from vertical to horizontal as illustrated. Adjustments are easily made internally and *do not alter the outward appearance of the unit.* For ease in system balancing, opposed-blade, gang-operated volume controls are available. Actual tests in the laboratory and on the job prove the superior performance of the UNI-FLO Square Ceiling Outlet.

BARBER COLMAN

Write for Bulletin F-4728

BARBER-COLMAN COMPANY, 1224 Rock Street, Rockford, Illinois

Can you afford to waste what Iron Fireman users are saving?



Iron Fireman underfeed stokers are available in capacities up to 400 boiler horsepower.

Iron Fireman Pneumatic Spreader
Dries, pre-heats, conveys coal pneumatically. Burns low cost coals efficiently. Up to 1000 boiler h.p. with multiple units for larger boilers.

Iron Fireman Rotary Oil Burner
Fires low-cost, heat-rich heavy oils (5 & 6) with complete steadiness and dependability at varying oil temperatures. Cap. to 500 b.h.p.

Iron Fireman Commercial Gas Burner
Verticle type is illustrated above. Others include Radiant Inshot and Ring types. Flexible operation, easy to install. Capacities to 400 b.h.p.

Here's a complete *COAL HANDLING* and *COMBUSTION SYSTEM* — all in one package

To coal's basic advantages (low cost and availability) Iron Fireman stokers add many new ones:

1. Coal is fed direct from the coal bunker or bin without manual handling.

2. Iron Fireman precision controls are extremely accurate and dependable. They are capable of automatically adjusting the stoker firing rate to the boiler load, even when steam demands fluctuate from a "stand-by" status to the maximum capacity of the boiler.

3. Air and fuel are so perfectly proportioned that the clean, brilliant fuel bed produces a maximum amount of heat per fuel dollar.

For further information mail the coupon below, or call your local Iron Fireman dealer for complete survey of your boiler plant. There is no cost or obligation to you.

IRON FIREMAN MANUFACTURING COMPANY
3155 West 106th Street, Cleveland 11, Ohio.
Please send literature as checked:

☐ Coal-Flow Stoker ☐ Rotary Oil Burner
☐ Pneumatic Spreader Stoker ☐ Commercial Gas Burner

Let Iron Fireman engineers help decide which fuel is best for your plant.

*Name*_____

*Address*_____

IRON FIREMAN

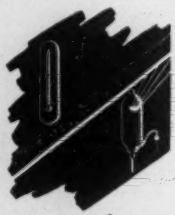
AUTOMATIC FIRING EQUIPMENT FOR OIL, GAS, COAL

...here are the reasons why

Grant Wilson DUX-SULATION

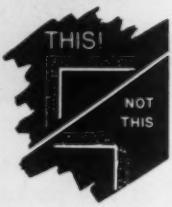
(ASBESTOS PROTECTED)

is BEST FOR DUCT INSULATION



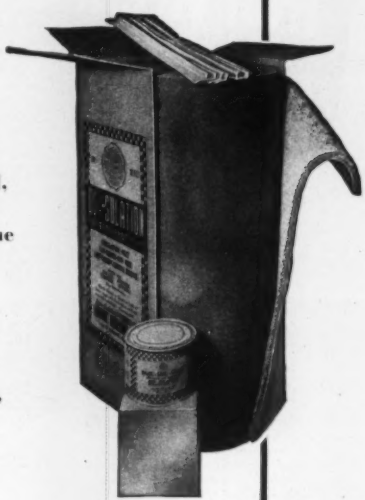
1. High thermal and acoustical insulating properties . . . K factor of .27 BTU and sound absorption approximately 61%. Integral, woven asbestos membrane.

2. Easy to handle, easy to install *correctly*, can't be crushed or cracked, springs back to original thickness if compressed. Supplied with special glue and tape, no "fasteners" needed.



3. Constant insulating values. Can't "powder", shift or sift; no thin spots, even at corners. No deterioration of any kind, no *change* of any kind.

4. Perfect adhesion, flexible, conforms to uneven surfaces. Tough enough to be installed in the shop and still withstand all necessary handling. Not just "adapted" for duct work, but specifically engineered for duct application ONLY!



Inspect Dux-Sulation yourself!

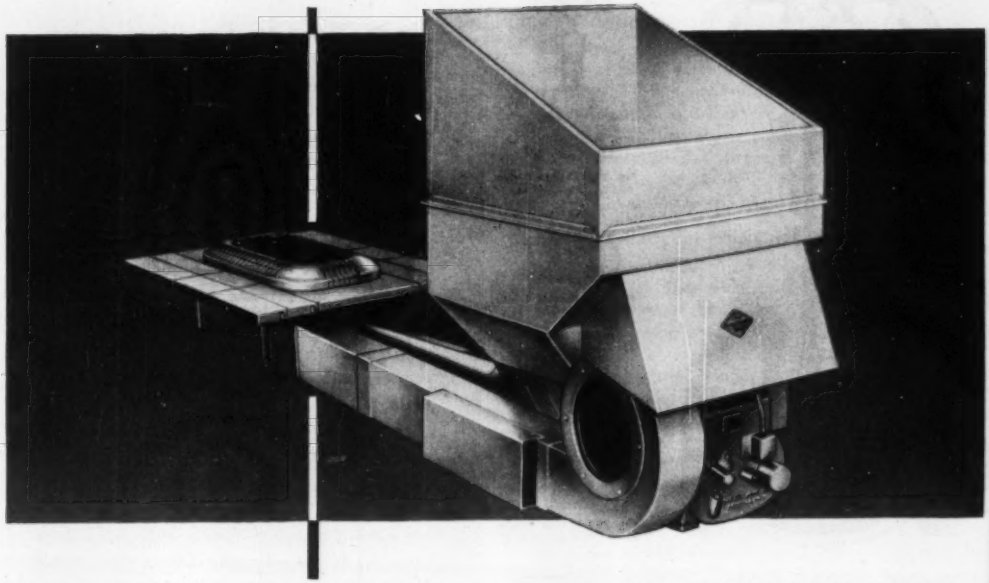
Write Grant Wilson, Inc. 141 W. Jackson Blvd., Chicago 4, Illinois. Ask for Sample Kit No. 534-H.

Grant Wilson inc.

ASBESTOS and INSULATING MATERIALS

IN NEW YORK CITY: Air Conditioning Utilities Co., 8 West 40th Street, New York 18, N. Y., LOngacre 3-4280.
IN CANADA: Atlas Asbestos Co., Ltd., Montreal, Toronto, Winnipeg, Vancouver.

A WILL-BURT STOKER
makes a good coal-heat installation BETTER

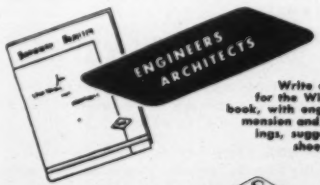


There is no guess-work when you specify or install a Will-Burt stoker. Its design, materials and workmanship are the result of 20 years of field and engineering experience.

The effective, trouble-free Will-Burt automatic air control is one of the important Will-Burt contributions to efficient combustion and smoke abatement. In fact, Will-Burt ***originated*** the application of air control to stokers within the Will-Burt size range. The Will-Burt air-control device has proved its superiority throughout these many years.

The quality which characterizes ***every*** detail of a Will-Burt stoker insures approval by the buyer for him who specifies or installs a Will-Burt. Will-Burt stokers build reputations . . . year after year after year.

They are available in a full range of sizes, hopper and bin fed, in capacities up to 600 pounds per hour.



Write on your letterhead for the Will-Burt stoker data book, with engineering facts, dimension and installation drawings, suggested specification sheets, etc. Valuable!

OTHER WILL-BURT HEATING PRODUCTS

Gas and oil conversion burners

Residential hot-water heating boilers

WILL-BURT

THE WILL-BURT COMPANY

DEPARTMENT H ORRVILLE, OHIO

NEW JENKINS VALVES for Safety and Economy in L.P.G. Services

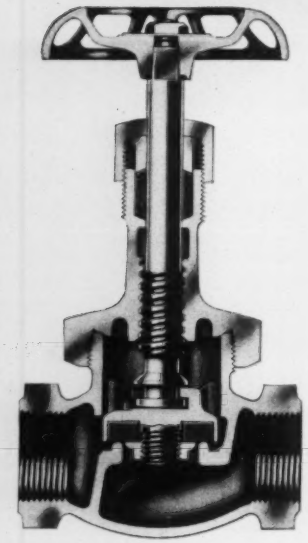


Fig. 506 Bronze Globe
400 lbs. O.W.G. ¼" to 2"

Fig. 507 Bronze Check
400 lbs. O.W.G. ¼" to 2"

Fig. 508 Bronze Angle
400 lbs. O.W.G. ¼" to 2"

APPROVED BY UNDERWRITERS' LABORATORIES,

SPECIAL DESIGN FEATURES

provide high strength and trouble-free, tight closure to meet all tests

EXTRA HEAVY, REINFORCED BODY. Liberally proportioned construction, with reinforcing rib along center line, and heavy lug ends. Will take all ordinary pipe strains without distortion, and provides a factor of safety far above any L.P.G. service needs.

CROWNED SEAT Insures positive tightness required to meet N.B.F.U. test of 500 p.s.i. under seat when valve is closed.

IMPROVED COMPOSITION DISC Meets every test of L.P.G. service. Retains resilience through entire range of liquid and gaseous phases from −50 F. to +150 F.

DEEPER PACKING BOX. Extra deep packing box and spiral, lubricated packing material permits spindle to turn with minimum friction. Dependable seal at this point and at valve seat is assured without excessive effort on handwheel.

BEVELED SPINDLE SHOULDER Back seats against corresponding bevel at bottom of bonnet when valve is full open. Relieves pressure on packing material.

ALL OTHER PARTS SPECIALLY DESIGNED and proportioned to meet rigorous requirements of critical L.P.G. service. Construction features of Fig. 507 Check and Fig. 508 Angle same as Fig. 506 Globe.

Sold Through Leading Distributors Everywhere

Liquified Petroleum Gas (butane-propane), commonly known as "bottle gas", has become a popular domestic fuel, and is now being widely used in industry. Piping systems for handling these gases must be controlled by valves specially designed for this hazardous service.

These new Underwriters' Approved Jenkins Valves for L.P.G. service offer strength and safety well beyond specified requirements. They are built to the same quality standards that make all Jenkins Valves the economy-wise choice for any service.

Where Gate Valves are required for L.P.G. service, Jenkins Fig. 270-U offers the proper ratings.

Because of their superior safety features, Jenkins L.P.G. Valves are also recommended for air, gasoline, oil, and similar services where exceptionally rugged, specially tested valves are needed. For complete details and dimensions, get the new Jenkins L.P.G. Valve folder, Form 197. Use the coupon. Jenkins Bros., 100 Park Ave., New York 17, N. Y.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros.

The complete line of JENKINS L.P.G. VALVES are described in this new folder. Mail coupon today.

JENKINS BROS., 100 PARK AVE., NEW YORK 17

Please send L.P.G. Folder—Form 197

Name.....

Company.....

Address.....

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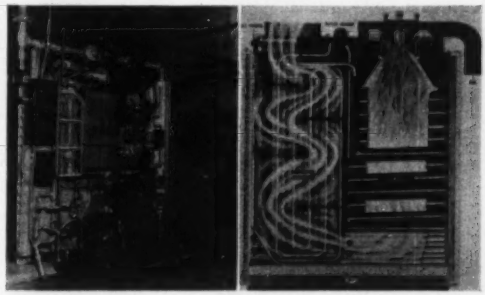
EQUIPMENT DEVELOPMENTS...

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1951 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in your Directory Section; double asterisk, equipment and manufacturer not listed

Packaged Steam Generator

HPAC 1—Originally developed for use in connection with railway train heating service, the "C-E Recirculation" steam generator of Combustion Engineering - Superheater, Inc., 200 Madison Ave., New York 16, is now being offered for industrial applications. The generator may be fired by light or heavy fuel oil or by natural gas. It is available in several sizes for steam capacities from 2800 up to 6000 lb per hr and for operating pressures up to 300 psig.



Two burners are used. For starting, a small "all-on" or "all-off" electrically-ignited burner is operated by a pressure limit switch. It is limited to a steam demand of 700 lb per hr, after which a larger burner is cut in and operated up to maximum rating. Fuel oil and air to the larger burner are adjusted by the combustion control in accordance with load demands. Air for combustion is supplied by a blower and regulated by a damper controlled by the pressure of fuel oil. The fuel oil pressure is, in turn, controlled by the steam pressure. The feedwater pump, controlled by a float system in the separator drum, pumps the feedwater to a closed heat exchanger where it is preheated by the heat of its exhaust steam. The feedwater then enters the outlet header and the steam separator, where it is deaerated.

Delayed Opening Oil Valve

HPAC 2—A new delayed oil valve, designed to eliminate most causes of sooting in oil fired heating plants and designed for use on new and existing high pressure burners, is available from Minneapolis - Honeywell Regulator Co., 2604 Fourth Ave., S., Minneapolis 8.

In operation, says the company, the valve holds up the flow of oil to the burner nozzle until the proper air supply is available. The heart of the system is an electric resistor which delays the opening of the solenoid valve for about 4 sec after the burner motor starts. This delay permits the burner fan to get up to speed before oil is discharged through the nozzle. The valve can be installed at any point between the fuel pump and the burner nozzle. Because the solenoid is spring loaded, the valve can be mounted in any position and is designed to close instantly in the event of power failure.

Scraper Strainers for Pipe Lines

HPAC 3—In the pipe line scraper strainers of Sarco Co., Inc., Empire State Bldg., New York 1, motor driven scraper blades rotate like worm gears inside cylindrical screens. The rotor blade scrapes off the dirt as it is trapped.

According to the company, advantages include the elimination of shut-downs, the labor-consuming job of removing and cleaning dirty strainer screens, the elimination of the hazard of foreign particles being forced through a dirty screen, the fact that a relatively close mesh screen may be used, and the removal of solids or scums without interruption of flow of any fluid, including paint, tar fuel, resins, river water, wax, brine, etc.

According to the company, units are custom-built for almost every installation.

Combustion Safeguard

HPAC 4—A new electronic combustion safeguard system for commercial oil burners is available from the control divisions of General Electric Co., Schenectady 5, N. Y.

FOR YOUR CONVENIENCE (4-51)

Heating, Piping & Air Conditioning
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each HPAC number in which you are interested)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26				
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138		

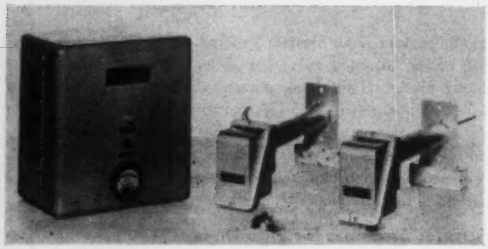
Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

The equipment includes a switch-amplifier-contactor unit, a phototube holder, and an electrode holder. According to the company, the system assures positive protection against combustion failure because (1) if the gas pilot does not ignite, the oil valve cannot open, and (2) if the oil flame does not ignite, the supply of fuel is cut off. After cutoff, the motor continues to operate for 30 sec to purge the nozzle or cup of unburned fuel to prevent carbonizing and reduce field servicing. The system is then locked against further operation until reset.



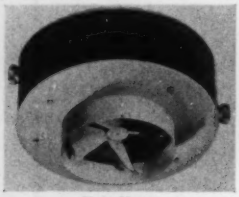
An oil temperature thermostat can be used with the circuit in this control to assure satisfactory fuel oil temperature before the starting cycle begins. When continued operation of the burner is prevented by ignition failure, a positive lock-out mechanism is actuated and a light on the cabinet cover indicates that the equipment has gone to lockout. Operation cannot then be resumed until the reset button is pushed.

Vertical Discharge Unit Heater

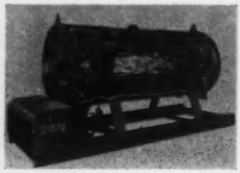
HPAC 5—A new vertical discharge unit heater of the circular type has been developed by C. A. Dunham Co., 400 W. Madison St., Chicago 6.

According to the manufacturer, the circular heating element is designed to operate at peak efficiency with a minimum number of joint connections. The header design and location of supply and return piping on the sides of the element are said to permit a simplified piping hookup with relatively few pipe fittings. A slow speed fan is used and the motor is rubber mounted. Three types of diffusers (an adjustable cone diffuser, three and four cone "Anemostats", and a new radial louver diffuser) are available, and the choice of diffusers permits the heater to be installed at heights ranging from 9 to 32 ft.

Capacities of the seven sizes range from 21,700 to 492,000 Btu per hr under standard conditions.



Unit Heater



Steam Generator

Packaged Steam Generators

HPAC 6—The 1951 line of "Steam-Pak" packaged steam generators of York-Shipley Inc., York, Pa., features a new combustion chamber design.

In all models, from 15 to 250 hp, the flame swirls in a circular motion through the combustion chamber. This is said to provide unusual heat absorption and high heat transfer and at the same time to form a protective circle of preheated air around the flame so as to prevent impingement and burning out of the carborundum combustion chamber. The swirling flame action, says the company, is created by blowing swirling excess air into the chamber around the burner. At the center of the combustion chamber is located a factory-adjusted carborundum ring used to regulate the length of the circulating flame by squeezing it and drawing excess air into the center.

Generators are available for low or high pressure steam or hot water, and for burning heavy oils, gas or combination gas and oil.

Square Ceiling Air Diffuser

HPAC 7—A new "Uni-Flo" square ceiling air diffuser has been developed by Barber-Colman Co., Rockford, Ill.

It is designed and sized to match standard acoustical tile and to blend with the ceiling pattern. Another model of the same outlet has a surface flange making it suitable for installation in plaster ceilings. According to the company, air supply can be adjusted from vertical to horizontal after installation and can be set to discharge air in one, two, or three directions or to provide full 360 deg distribution. None of these adjustments alters the outward appearance of the unit, which, without modification, can be used as a return air opening. A variety of finishes is available to match installation surroundings.

Ceiling Air Diffuser

Rubber Belt

Rubber Belt with Teeth

HPAC 8—A new rubber and fabric belt with teeth, said to fulfill the need for a power drive which will not slip and which will permit split-second precision timing, is being marketed by the L. H. Gilmer Div., United States Rubber Co., Philadelphia.

The belt is similar in appearance to a flat belt except that it has regularly spaced rubber teeth along its inner surface which engage in corresponding grooves in pulleys. According to the company, it may be used at speeds up to 16,000 fpm. It is recommended for use in portable tools, for fan belt service, for high speed pumps, and for many types of industrial machinery.

At the present time, production is limited to specifically engineered applications. However, the company expects to offer a standardized line of stock drives in both heavy and light duty constructions.

Automatic Hidden Arc Welding

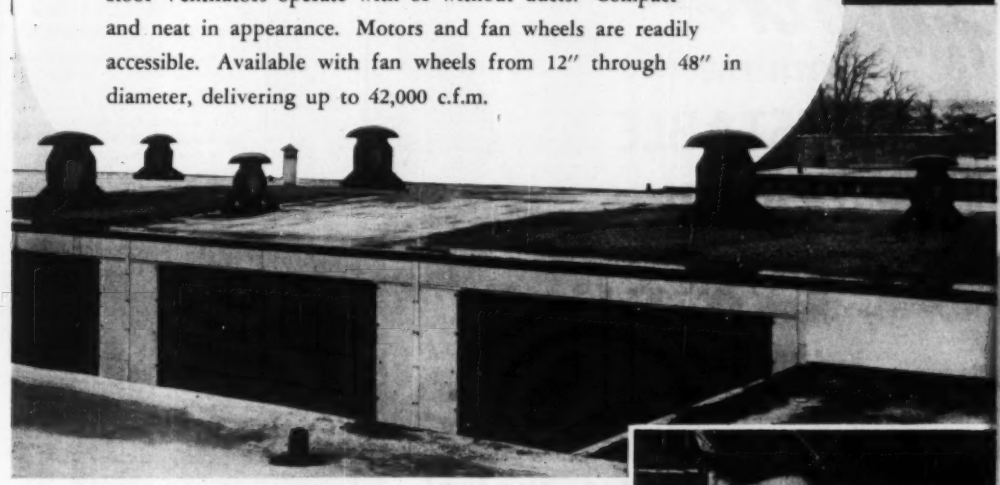
HPAC 9—According to Lincoln Electric Co., Cleveland 1, Ohio, automatic hidden arc welding has heretofore

[*Continued on page* 192]

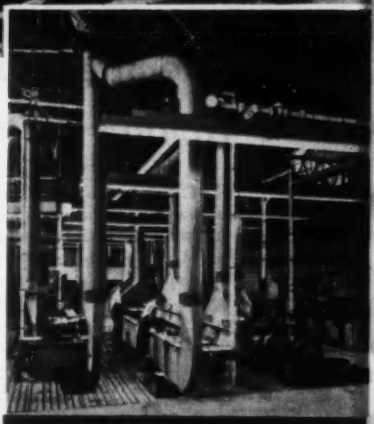
Exhaust Dangerous Fumes

THIS SAFE, EFFICIENT WAY

DeBothezat Bifurcator Roof Ventilators are ideal for exhausting abnormally hot air, corrosive, explosive or toxic fumes. Bifurcator Roof Ventilators operate with or without ducts. Compact and neat in appearance. Motors and fan wheels are readily accessible. Available with fan wheels from 12″ through 48″ in diameter, delivering up to 42,000 c.f.m.

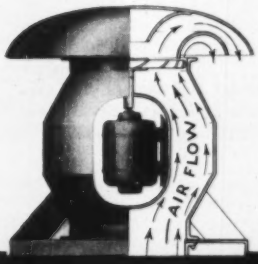


6 DeBothezat Bifurcator Roof Ventilators provide both air intake and exhaust for "push-pull" system of plating tank ventilation. Photos courtesy of General Electric Company



HOW THE BIFURCATOR FAN WORKS

The DeBothezat Bifurcator is a direct motor-driven fan with a divided housing. Gases are by-passed around the motor, which is mounted in a separate chamber — open to atmosphere but isolated from exhaust fumes. Bifurcator Roof Ventilators are equipped with weatherproof head and mounting base.



BIFURCATOR ROOF VENTILATORS

DE BOTHEZAT FANS DIVISION

American Machine and Metals, Inc., East Moline, Illinois

Certified Ratings AMCA

WRITE FOR COMPLETE INFORMATION
Address Dept. HP-450

demand

DETROIT CERTIFIED CONTROLS

ONLY DETROIT OFFERS

TIMED CYCLING

WITH THE

ADJUSTABLE PARALLEL HEATER . . .

TIMED CYCLING
Gives Your Customers

Uniform room temperature—controlled within a fraction of a degree • Elimination of the waste and discomfort of over and under heating • Greater fuel economy • Automatic adjustment of heating to all existing influences, such as outside temperature, wind direction and velocity, solar radiation, etc. • Geared-to-the-weather heating.

a turn of a screw

tailors temperature control to fit any installation!

DETROIT'S No. 411-CH *Timed Cycling* Thermostat is a natural for all your new installation and conversion jobs. Equipped with an easily adjustable parallel heater, the No. 411-CH can be swiftly adapted with minimum effort to provide maximum comfort under a wide variety of installation conditions. With a simple turn of a screw, cycles can be shortened or lengthened to fit the specific installation without disturbing the factory settings. Because the unique *Timed Cycling* parallel heater is not affected by variations in the electrical load, this remarkable thermostat may be used on *all* types of installations and is particularly well adapted to conversion burner work where the heating unit is either over or under size. In addition, the *Timed Cycling* Thermostat eliminates the need to select a special heater by giving you *one* heater adaptable to *all* jobs. This exclusive feature greatly simplifies inventory, installation and service problems and assures your customers the utmost in heating comfort. For complete information see your DETROIT wholesaler today.

Write for Form No. 1545

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LUBRICATOR COMPANY

5900 TRUMBULL AVE., DETROIT 8, MICHIGAN
Division of American Radiator & Standard Sanitary corporation
Canadian Representatives: RAILWAY & ENGINEERING SPECIALTIES, LTD.—Montreal, Toronto, Winnipeg

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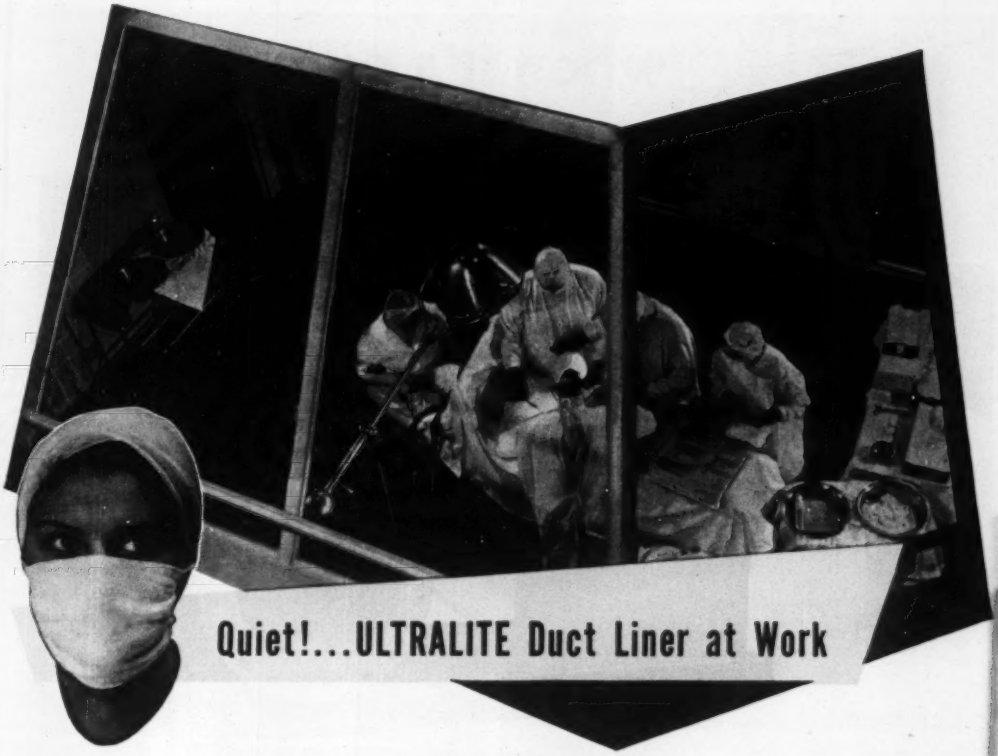
DETROIT HEATING AND REFRIGERATION CONTROLS • ENGINE SAFETY CONTROLS • FLOAT VALVES AND OIL BURNER EQUIPMENT • DETROIT EXPANSION VALVES AND REFRIGERATION ACCESSORIES • STATIONARY AND LOCOMOTIVE LUBRICATORS

Serving home and industry. AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON



Quiet!...ULTRALITE Duct Liner at Work

What a difference a few feet of Ultralite Duct Liner can make in heating and air conditioning systems! For Ultralite's long glass fibers soak up objectionable sound, reduce "fan chatter" to a w-h-i-s-p-e-r. With just a few feet of Ultralite in the plenum and supply ducts, heating and air conditioning systems can operate at peak efficiency without disturbing anyone. It costs so little to make sure "the job is right;" try Ultralite on your very next job!

ULTRALITE is the duct liner that **won't burn**—a flexible, resilient, semi-rigid glass fiber insulation designed specifically as acoustical duct liner. (It also has excellent thermal properties.) Ultralite Duct Liner won't break, flake, or chip, won't delaminate, won't flake off in air stream. You can run it quickly around curves and corners, fasten it in place with screws and washers or adhesives.

FOR WRAPPING OUTSIDE OF DUCTS, use Ultralite Duct Insulation—it's as simple as wrapping a package! Ultralite Duct Insulation is available plain or with your choice of 4 different vapor barrier facings. Use coupon for more details.

GUSTIN-BACON ULTRALITE INSULATION MANUFACTURING CO.

GUSTIN-BACON MFG. CO.

1412 WEST 12TH ST., KANSAS CITY, MO.

New York Chicago Philadelphia San Francisco Los Angeles Houston Tulsa Ft. Worth

HP-4

Please send me ULTRALITE Duct Liner and Duct Insulation samples, specifications, and catalog A.I.A. File No. 37-D-2.

Name_____

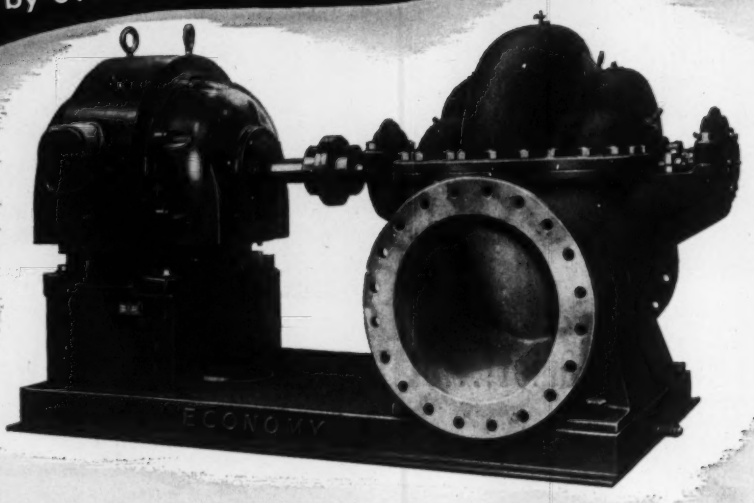
Company_____

Address_____

City_____ State_____

when it's pumps, think of Economy

backed by over thirty years of specialized experience



The Type M Single Stage Double Suction Pump illustrated is just one of the many in the extensive line manufactured by Economy Pumps, Inc. This exceptionally rugged design is available in capacities from 50 to 30,000 gallons per minute at heads to 300 feet. A general purpose pump, it is ideally suited to general water supply or heavy mill service.

Maintenance expense is held to a minimum. Case records show Economy Pumps operating for fifteen to twenty years without replacement of major parts. However, should repairs be necessary, all parts subject to wear are renewable.

Economy Pumps are tested in accordance with the standards of the Hydraulic Institute and the A. S. M. E. under conditions duplicating as nearly as possible those encountered in actual service.

Catalog No. A750 gives complete design and construction details, also some interesting typical examples of performance, as well as handy selection tables. Write Dept. C-4 for your copy.

Economy Pumps Inc.

DIVISION OF HAMILTON-THOMAS CORP., HAMILTON, OHIO

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. . . the latest accepted data on friction loss in ducts and methods of duct design
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. . . general information on 50 subjects selected as most important in the heating, ventilating, air conditioning field

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TYPICAL SECTIONS

AIR CONTAMINANTS — Shows latest acceptable limits for toxic gases. AIR DISTRIBUTION — Illustrates methods of obtaining proper air flow and distribution. Formulas for air flow and charts for graphical solution of problems. AIR DUCT DESIGN — Air friction charts for two ranges based on recent studies of ASHVE Research Laboratory. Method of correcting for pipe roughness given. Formulas and tables for circular equivalents of rectangular ducts. CODES — Convenient reference to 133 Codes and Standards giving source. COOLING LOAD — Design data for 315 cities. Solar heat gain tables for glass and glass block derived from ASHVE research. Simplified method of calculating heat gain through walls and roofs. DRYING SYSTEMS — Theory of drying explained Typical dryers illustrated. Methods of drying described. FLUID FLOW — Basic theory of fluid flow through pipe, nozzles and orifices, presented clearly and concisely. FUELS COMBUSTION AND EQUIPMENT — Describes properties of various fuels and methods of burning. Gives formulas and methods for computing combustion losses. Adjustment and operation of fuel burning equipment explained. HEAT LOSS CALCULATIONS — Includes basic formulas and extensive tables for determining building heat loss for typical construction. Data on soil conductivity included. INSTRUMENTS — Outlines methods of measurement and instruments used in heating, ventilating and air conditioning. OWNING AND OPERATING COSTS — Shows method of establishing actual cost of air conditioning to the owner. PANEL HEATING — Simple presentation of principles and method of design. Charts simplify calculations. PHYSIOLOGICAL REACTIONS — Discusses principles and research upon which proper air conditions for human occupancy are based. Comfort chart is included. Describes effect of air conditioning in preventing and treating disease. REFRIGERATION — Simple presentation of the different refrigeration cycles, and brief treatment of most commonly used equipment arrangements and controls. New table shows factors affecting use of various heat sources and sinks. THERMODYNAMICS — Simple presentation of thermodynamics in air conditioning. Includes Tables on Properties of Moist Air from —160 F to +200 F. and water from —160 F to +212 F. New ASHVE Psychrometric Chart included. WARM AIR SYSTEMS — Design of both gravity and forced circulation systems presented in simplified form. Warm air perimeter systems described. WATER SERVICES — New values for per capita water consumption given. Method outlined for sizing piping for hot and cold water, cooling water and refrigeration.

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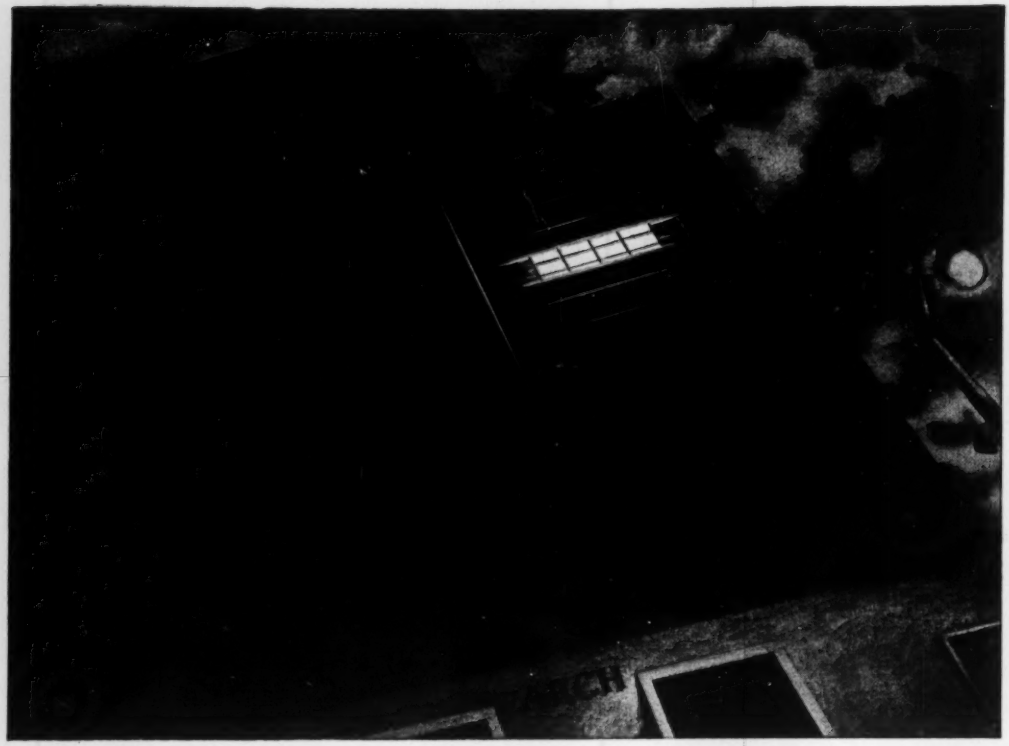

The light in the "Lab"

In the research laboratories of hospitals, clinics, and medical schools throughout our country, the lights burn late . . . as scientists constantly strive to halt humanity's greatest enemy—CANCER.

As the lights continue to burn, the hope for a cure grows brighter . . . here's why:

Cancer Research Is Paying Off

Through research—which you have helped to support by donating to the American Cancer Society—medical science now has new weapons to combat this disease more effectively than ever:

Drugs—there is evidence that a chemical treatment for cancer may be perfected. Certain drugs will prolong the lives of cancer victims . . . other promising compounds are being tested.

Hormones—treatment with hormones, such as ACTH and Cortisone, has brought about dramatic, although temporary, effects in some types of cancer. Other hormones have helped control *advanced* cancer of certain organs.

X-rays—the development of more powerful machines promises to make this form of treatment more effective.

Isotopes—radioactive chemicals are becoming increasingly useful in treating certain rare forms of the disease.

In addition, surgical technics have been improved so much that once hazardous operations can now be performed safely. And progress is being made in the development of tests to detect cancer in its earliest stages when the chances for cure are best. Research has made these life-saving advances possible. But, as long as cancer continues to kill some 210,000 men, women, and children in our country each year, we *must* keep the lights burning in the laboratories! *Much more research needs to be done before cancer can be dealt the final blow!*

Your life—the life of everyone you know—is at stake. Give generously to the 1951 Cancer Crusade.

Help Science Help You . . . Give To Conquer Cancer

Mail your contribution today to

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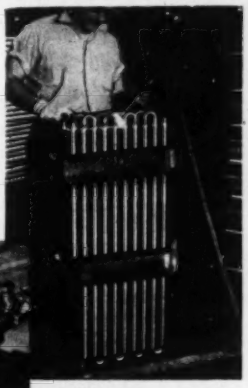
EASY-FLO and SIL-FOS alloys make torch brazing so easy that unskilled operators—men and women—can give you fast production of top-quality joints after only a few hours training.



In the "home made" turn-table and fixed torch set-up above, all operator does is position assemblies with alloy preplaced and step on pedal. With such simple equipment you can speed torch brazing 'way up and make it practically fool-proof.

ALWAYS USE HANDY FLUX with EASY-FLO and SIL-FOS . . .

to get the full benefit of the low flow points of these alloys which go from 1135°F to 1300°F. At 1100°F. HANDY FLUX is fully liquid and active and dissolves practically all refractory oxides, chrome oxide included. In addition, HANDY FLUX has excellent cleaning properties and washes off readily in hot water after brazing. In convenient paste form, it is easy to brush on and stays put. For details write for Bulletin No. 9.

LOW-TEMPERATURE EASY-FLO AND SIL-FOS SILVER ALLOY BRAZING is so extremely simple, so fast and so versatile that it is *just naturally a low-cost process.* For the same reasons it is readily adapted to give you any metal joining production you need, whether it's only a hundred joints a day or thousands.

You can get the benefit of the inherent speed and economy of the process whether you join ferrous, non-ferrous or dissimilar metals. What's more you can be sure of joints that are—exceptionally strong and ductile—liquid and gas tight—high in electrical and heat conductivity – resistant to corrosion – because every properly made EASY-FLO and SIL-FOS alloy joint *has all of these properties.*

The cases illustrated, typify the ready adaptability of the process which has enabled thousands of manufacturers to turn out *better* products with big savings in time—labor—cost. It will do as much for you.

WE ARE READY TO HELP YOU

With no obligation to you, we will send a field engineer to help you determine where and how you can use EASY-FLO and SIL-FOS brazing to your profit. This man has a wide background of brazing experience and can help you all the way from joint design through production and operator training. For EASY-FLO and SIL-FOS brazing facts in print, write today for Bulletin 20 and Bulletin 17 which tells how to braze pipe and tubing.

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Time spent in checking and adjusting low air velocities can account for a large part of the cost of any installation or service job. The fastest and surest way to measure air velocities in the lower ranges is with the Alnor Thermo-Anemometer. With laboratory accuracy this direct reading, self-contained instrument makes possible extremely precise readings—as low as 5 f.p.m. Drafts within occupied rooms . . . flow from convectors, grilles, registers . . . air flow in refrigerated spaces . . . these and many more are ideal uses for this compact, portable instrument. Send for complete details.

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[*Continued from page 184*]

been limited in application to jobs where the joint to be welded is in position for downhand welding. A new process, developed by the company, is said to remove this limitation and to extend the advantages of automatic hidden arc welding.

Referred to as "3 o'clock" welding, the new process is said to greatly reduce the cost of welding and to expand the possibilities for the application of hidden arc techniques. Because joints can be positioned horizontally, welds from both sides of the joint can be made simultaneously. In addition, relatively small electrode wire is used.

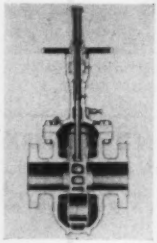
The process is said to be ideal for numerous applications, including the fabrication of pipe and storage tanks.

Pipe Line Gate Valves

HPAC 10—Crane Co., 836 S. Michigan Ave., Chicago 5, has developed a new line of class 600 cast steel pipe line gate valves designed to assure maximum flow-through with the least possible restriction.

Working parts are completely enclosed and packed in grease. The double-seating design is said to virtually eliminate seat erosion, and in open or closed positions, the seating surfaces are entirely sealed off from flow. According to the company, the passageway as formed by the double-seating double disc, is smooth and without pockets so that turbulence is avoided.

Valves are made in "Ful-Way" and venturi patterns, with flanged or butt-welding ends. They conform to applicable standards for the 600 lb pressure class listed by the ASA and API. Venturi valves are recommended only for gas service. Others are recommended for handling crude oil, finished products, or gas.



Above: Splashproof Motor

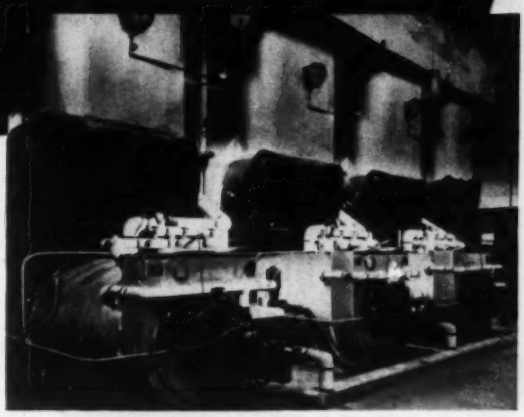
Left: Gate Valve

Splashproof Motors

HPAC 11—Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, is offering new "Life-Line" splashproof motors designed for applications such as in the food industry where splashing or hosing down conditions exceed NEMA standards for splashproofing.

These motors incorporate gasketed cast iron conduit boxes with provision for attaching waterproof conduit. Motor windings are given multiple dips and bakes in moisture-resistant thermoset varnish. Baffles inside the rear splashproof hood are used to prevent water creeping up inside the hood. Neoprene seals on the shaft outside the splashproof housing are used to give protection against the entrance of the water into the bearing housing, even under severe hosing operations. For added protection,

Another Outstanding Installation of Ace UNIFLOW Oil Burners



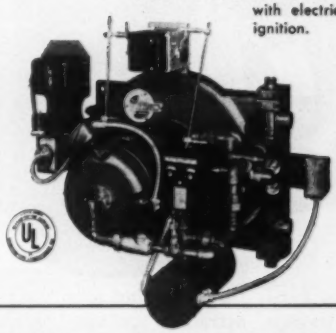
Three ACE UNIFLOW Oil Burners installed at Greenwich High School, Greenwich, Conn. Albert Fentzlaff, Inc., Engineers; Merit Oil Heating Corp., Mt. Vernon, N. Y., Contractors.

In commercial and industrial buildings throughout the country — wherever the finest heavy oil burning equipment is desired—you'll find ACE UNIFLOW Oil Burners .

At the Greenwich (Conn.) High School, three ACE UNIFLOW Oil Burners were selected by the Board of Education for the unusual installation shown here. To eliminate the need for raising the boilers, because of an unsatisfactory water condition, water wall furnace extensions were used.

This installation, designed and supervised by the ACE distributor for Connecticut—Arthur C. Beningson, of Stamford—is just one of the many applications of ACE UNIFLOW Oil Burners where their outstanding performance and dependability insure finest value in heavy oil burning equipment.

Type DREH fully-automatic, direct drive Ace Uniflow Oil Burner with electric-gas ignition.



TEN SIZES GIVE FOLLOWING RANGE OF CAPACITIES

	Gallons Per Hour	Boiler H. P.	Square Feet Steam Rad.
Minimum	4	12	1,600
Maximum	165	500	66,000

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Manufacturing horizontal rotary oil burners is our ONLY business — not a side line. Our entire efforts have been, and will continue to be, devoted to the design, engineering and sale of heavy fuel oil burning equipment through authorized dealers.

An Ace manual for architects and engineers is yours for the asking. Get full details on Ace Uniflow Oil Burners today.

ACE ENGINEERING COMPANY

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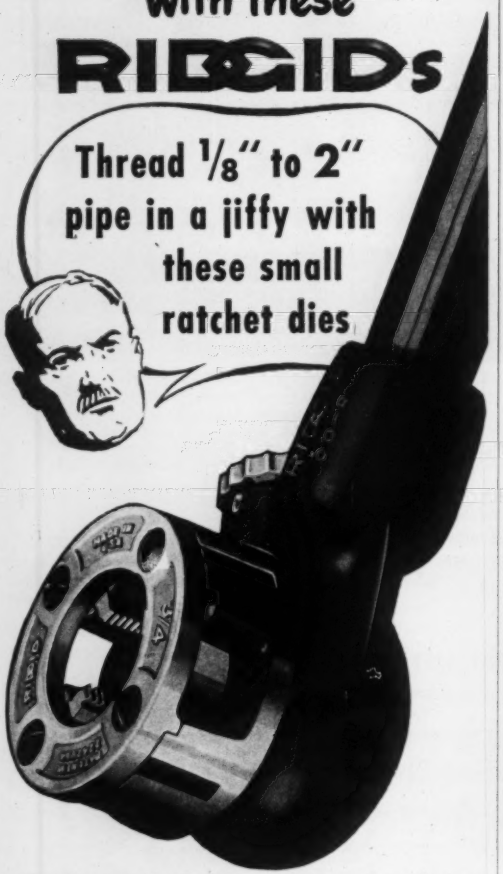


• The handy threaders that give you smooth perfect threads—extra fast and easy! Quick get-ready—just snap in the size die head you want and start threading. Die heads snap in from either side—can't fall out. Dies are precision-cut of fine tool steel. No special dies needed for close-to-wall work. Ask your supply house for work-saver RIDGID No. OOR, 1/8" to 1"; No. 111R, 1/8" to 1¼"; No. 12R, 1/8" to 2"—free carriers with sets.

RIDGID
★ Work-Saver Pipe Tools ★

grease seals are located between the outer periphery of the brackets and the splashproof hoods.

Motors, available in frames 326 and smaller, incorporate prelubricated ball bearings.

Air Conditioning Equipment

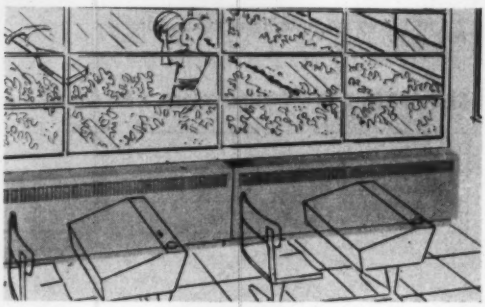
HPAC 12—Carrier Corp., Syracuse, N. Y., is now producing a complete line of new or improved air conditioning products — within the present limitations of the national defense program and with some models being produced only on defense orders.

The company's dealer line includes three instead of six models of room air conditioners, five packaged "Weathermakers" in sizes ranging from 3 to 15 hp, evaporative condensers in expanded capacities, a now completely portable "Humidry" for removing moisture in damp spaces, a new model cooling tower, a wide range of reciprocating compressors, and commercial air conditioning units up to 75 hp.

A new line of compact hermetic condensing units in the 3, 5 and 7½ hp range will be produced on defense orders only. Further savings in scarce materials will be achieved through the elimination of certain models using a high proportion of critical metals and by increasing unit capacity in others.

Window Sill Radiator

HPAC 13—Introduced at the recent 10th International Heating, Ventilating & Air Conditioning Exposition, the new "Sil-Type" radiator of Rittling Corp., Rand Bldg., Buffalo, N. Y., is recommended for use in schools, apartments, offices, and other buildings featuring continuous sash construction.



Constructed of rust-resistant metal with a prime coat, the units are available in virtually any sill depth or height. According to the company, the radiator may be used to provide temporary heat. It provides a window sill and becomes the finished wall under the windows, thus eliminating a considerable amount of plastering and wall finishing.

Designed to combine radiant and convected heat, it incorporates heating elements utilizing steel fins mechanically bonded to seamless steel tubing.

Tungsten Electrodes

HPAC 14—New tungsten electrodes, said to reduce inert-arc welding costs, have been developed by the welding divisions of General Electric Co., Fitchburg, Mass.

Major applications of the new "Hi-Thoria" electrodes, says the company, will be for inert-arc welding with direct

current, straight polarity using either argon or helium gas. This type is usually used to weld mild steel, stainless steel, copper, and various alloys.

According to the manufacturer, the electrodes will produce a stable arc over a relatively wide range of currents and will resist contamination by weld metal.

Submersible Pump

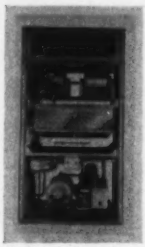
HPAC 15—The new submersible pump of Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, is a self priming, deep well pump installed below the water level. It is water cooled and water lubricated.

The unit is designed to deliver "unusually high" capacities at settings in excess of 70 ft with well diameters of 4 in. and larger. Priming is never required, as all operating elements are under water. The motor and pump are assembled in a tubular frame and the motor embodies a sealed rotor and stator. The motor relay and capacitor are located in a control box above ground. Impellers operate on a stainless steel shaft and rotate in rubber bearings. Undesirable motor noise and vibration, says the company, are eliminated because the entire pumping unit operates under water.

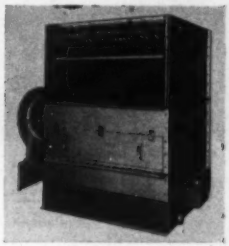
Packaged Air Conditioning Units

HPAC 16—The new line of packaged air conditioning units of Baker Refrigeration Corp., Sound Windham, Me., incorporates a number of design changes.

Said to feature greater cooling efficiency in a more compact design, the new line is built in capacities of 3, 5, 7½ and 10 tons. Overall height has been substantially reduced in each model and unusually quiet operation is said to be assured by the use of vibration-eliminating spring compressor mountings. According to the company, cooling efficiency has been increased through a new cooling coil in the compressor compartment to dissipate heat. New water and drain connections are used and models may be obtained with either open type or hermetic compressors.



Packaged Conditioner



Cooling Tower

Cooling Towers

HPAC 17—Binks Mfg. Co., 3122 Carroll Ave., Chicago 12, is now offering new and improved "Dry-Fan" cooling towers.

Of the blower type, these towers are manufactured in two models. The 2-B series is a single fan unit available in nine sizes with capacities ranging from 3 to 30 tons of refrigeration. The 2-BB series towers are equipped with

For nearly half a century Heating Engineers and Contractors have found that

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With confidence that they will really save oil, and that their operating and maintenance costs will be low. Every burner we produce has been engineered to give that kind of service.

We've been building oil burners for 48 years. From the first, we have aimed at producing *more heat* from *less oil*. All our accumulated experience, all our engineering skill has been concentrated on that goal. It's little wonder that the long-term performance of our burners is hard to equal . . . and that heating experts, the world over, have come to think of "Johnson Oil Burners" as one of the great names in the industry.

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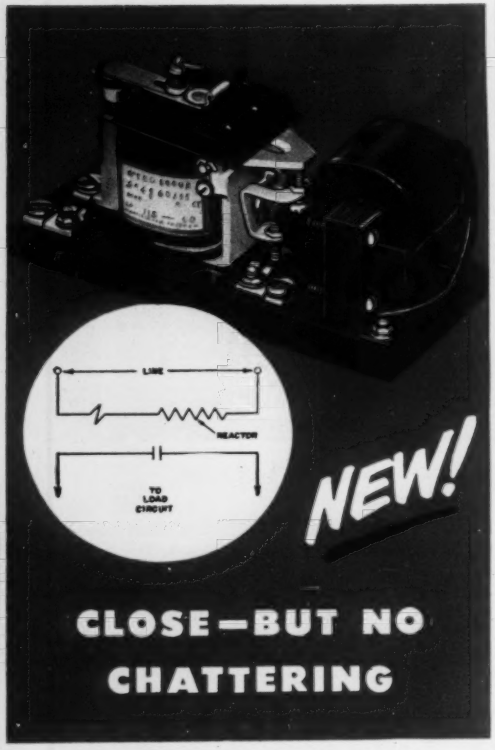
Johnson Oil Burners



New A-C voltage-sensitive relay makes ideal safety device

Bulletin 401 describes how voltage differential between pick-up and drop-out can be set at 10% (5% on special order)—without chattering—on Ward Leonard's new a-c magnetic relay.

Designed for safeguarding single phase a-c motors (such as on washing machines, oil burners, etc.) against burn-out caused by low voltage, the 401 relay is also ideal for a-c lighting and power bus transfer, voltage regulating, etc.

A small saturable reactor, connected in series with the relay coil, acts as a variable impedance, varying with voltage drop. Since it is the major impedance in the circuit, wide current variations through the coil can be obtained with small line voltage variations.

Being a power-type relay, it provides good contact, good make-and-break. Write for Bulletin 401. WARD LEONARD ELECTRIC CO., 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY

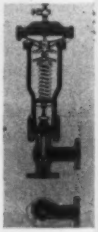
Result-Engineered Controls Since 1892

RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

two double inlet squirrel cage blowers and are offered in four sizes with capacities from 32 to 60 tons.

Air enters the cooling towers at the bottom and is exhausted through redwood drift eliminators at the top. For indoor installations, special adaptor hoods are available for the top of the tower. These are designed to simplify the connection of exhaust ducts. All units incorporate the company's "Rotojet" spray nozzles which are said to assure fine fluid break-up for maximum heat transfer.

Flow Regulating Valves



HPAC 18—The new type V10 valves developed by Swartwout Co., 18511 Euclid Ave., Cleveland 12, are designed to handle steam and water at high pressure drops, and especially flashing condensate. Uses are said to include drainage for heaters, evaporator coils, flash tanks, process systems, subcooled heaters, boiler blowdown, feed pump recirculation and other severe conditions where high velocity impingement is encountered.

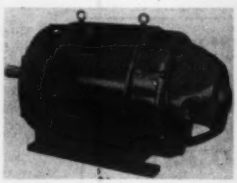
All internal parts of the valve are made of stainless steel and the unit features a scroll inlet and a gradually expanded straight outlet to eliminate direct impingement and resulting corrosion-erosion effects. Valves are supplied in seven pipe sizes ranging from 1 to 4 in. All sizes can be furnished in 150 to 600 psi standards with 900 to 1500 and 2500 psi standards also available.

Wound Rotor Motors

HPAC 19—Electric Machinery Mfg., Co., 1331 Tyler St., N.E., Minneapolis 13, has developed a new line of heavy duty, wound rotor induction motors.

These units provide variable speed drive and are said to be advantageous for applications requiring high starting torque and low starting current, or long acceleration periods.

Built in ratings from 30 to 1500 hp, drip-proof construction is furnished as standard. Splashproof or enclosed forced-ventilation models are also available. The fabricated steel frame is said to feature high physical impact strength and crackproof steel-bar feet. Motors are available with either ball or split-sleeve type bearings.



Above: Motor; Right: "Fluid Joists"

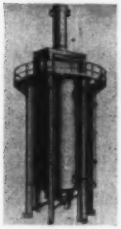
Combination Joists, Panel Heating Coils

HPAC 20**—"Fluid Joists" differ from standard metal joists in that common black pipe is used for the bottom chord member and serves to conduct a heating fluid as well as to support the roof or floor structure above. The new joists have been developed by Fred J. Fricke, structural engineer of 4404 Avenida Estrellita, Albuquerque, N. M.

According to Mr. Fricke, these joists should cost about the same as standard metal fabricated joists, and the cost of the end connection loops, the pipe supplying the feed and return lines, plus the boiler and automatic controls would normally be the only direct cost chargeable to the heating system. The connecting loops are welded after the joists are placed in position. In the illustration, the joists were left exposed for test and demonstration purposes.

Direct Fired Heaters

HPAC 21*—Struthers Wells Corp., Warren, Pa., is offering a standard line of direct fired heaters with capacities from 100,000 to 15,000,000 Btu per hr. Units are designed for a wide range of applications, including indirect circulating heating using heat transfer mediums, as well as for direct heating of vapors and liquids. Temperatures range to 750 F or above.



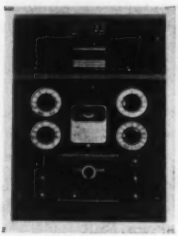
Automatic control systems are available, as are completely engineered systems (including all necessary equipment).

Units are recommended for use where a process requires heat at temperatures above the existing steam supply, where operation may be improved or speeded up by higher temperatures, and where it is desirable to supplement existing boiler capacity.

Electronic Control for Heating Systems

HPAC 22—All control panels now being manufactured for the steam heating systems of C. A. Dunham Co., 400 W. Madison St., Chicago 6, are equipped with the RST-EA-A electronic amplifier. The amplifier, which indicates and controls temperature changes, replaces a galvanometer as nerve center for the panel.

Advantages are said to include improved reliability of operation because of fewer parts and lower maintenance costs. The new control is located in the lower center portion of the control panel shown in the illustration.



Above: Thermal Insulation

Left: Heating Control Panel

Thermal Insulation

HPAC 23—With the recent addition of curved block to its line of heat insulation, Kaylo Div., Owens-Illinois Glass Co., Box 1035, Toledo 1, Ohio, is offering an unusually complete range of sizes and thicknesses. The range covers tubes and pipes from ¼ in. in diameter to 72 in. and vessels up to 60 ft.

Made of hydrous calcium silicate for use at temperatures up to 1200 F, insulation is made in standard sizes of block and in thicknesses from 1 to 6 in. for flat surface insulation. As preformed pipe covering, it is made in sectional form (two pieces to the circumference) for all standard

PEANUTS ARE
GREAT FOR ELEPHANTS

but Air Conditioning Dealers thrive on Profits

★★★★★

says

TYPHOON

No wringing of hands or crying in their beer by Typhoon dealers. They make money on air conditioning—year in, year out. For Typhoon's policy is: "every dealer must prosper." And Typhoon makes good on this policy with a brass tacks program that brings in more dollars for dealers.

TYPHOON 5-Way PROFITS PLAN

1. Typhoon, America's No. 1 specialist in packaged air conditioners, brings you the most complete line of units in the quick-profit range — 1½-2-3-5-7½-8-10-15 and 20-tons. There's a size for every job!
2. Typhoon units are engineered to deliver full rated capacity even after years of hard service. This means minimum servicing, maximum profits and good will.
3. Typhoon delivers air conditioning at the lowest dollar cost per ton capacity—value that means full markup for you.
4. Typhoon district managers give you 100% sales cooperation, with practical in-the-field training for your sales force.
5. Typhoon units are backed by 42 years of experience in the air cooling field . . . and by an advertising and promotion program that produces a steady flow of leads for you.

Want to know about the finest dealer setup in the business? Write us today.

TYPHOON AIR CONDITIONING CO., INC.

794 UNION STREET, BROOKLYN 15, NEW YORK

LOWER INSTALLATION COSTS
UP TO 50% SAVINGS ON MAINTENANCE
QUICKER HEAT
CLEANER PLANTS
LOWER FUEL BILLS

CYCLOTHERM
STEAM GENERATORS

Factories, Public Buildings, Institutions all over America are finding out what the U. S. Navy discovered during the last war: CYCLOTHERM'S Cyclonic Combustion Steam Generators do a BETTER job, quicker and cheaper.

Proof of this statement and why it is true may be had by writing the Cyclotherm Corporation directly or check your phone book for your local Cyclotherm office.

Boilers designed for oil or gas. From 18 thru 500 h.p., 15 to 200 lbs. operating pressure.

For further information, write Dept. N

CYCLOTHERM CORP., OSWEGO, N.Y.

tube or pipe diameters from ½ in. to 12 in.; tri-segmental form (three pieces to the circumference) for pipes and tubes up to 23 in.; quad-segmental (four pieces to the circumference) for pipes and tubes up to 41 in.; K-segmental (curved pieces 18 in. wide) for pipes and tubes up to 72 in.; and curved block nominally 18 in. wide for large vessels up to 60 ft in diameter. For diameters larger than 60 ft, flat block is used.

All pipe covering is made to simplified dimensional standards so that outside diameters of the coverings correspond to the outside diameters of standard pipes. The pipe coverings, therefore, can be nested.

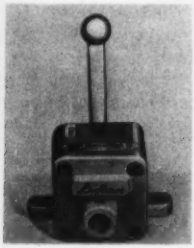
Substation Power Packs

HPAC 24—A new "midget" load center unit substation specially designed for low voltage, regulated a-c lighting and power service in factories and laboratories has been developed by the unit equipment division of General Electric Co., Schenectady 5, N. Y.

Called an "Inductrol" power pack, the unit incorporates in one steel housing an air circuit breaker, a dry type transformer, and an air cooled induction regulator. The new pack is available in either single or three phase ratings, has a capacity ranging from 15 to 100 kva, and is used to bring power to the load area at relatively high voltage (with substantial savings in cable). It is also used to reduce the voltage to the value required at the load center and to automatically maintain the reduced voltage.

The unit is recommended for use in connection with lighting, resistance heating and infrared heating equipment, electronic apparatus and precision instruments and control circuits.

Substation Power Unit



Cylinder Valve

Hydraulic Cylinder Valves

HPAC 25**—A line of valves for actuating air to hydraulic cylinders has been introduced by Ledeen Mfg. Co., 1602 S. San Pedro St., Los Angeles 15.

Units embody rotating discs and are available in 14 different models for five different cycles in six sizes and may be used for controlling the flow of air, oil or water. Hand-operated valves turn 45 deg each way from neutral, and foot operated valves turn 15 deg each way from neutral.

Finger or solenoid operated valves are actuated by two poppets which are depressed about ⅛ in. A pinion mounted on the stem of the valve disc is rotated by a rack-shaped piston, subjected to air pressure on both sides. Depressing one poppet exhausts the air from that side of the piston; the air pressure on the other side forces the piston to move to the opposite position, rotating the valve

disc 90 deg and reversing the flow through the ports to the cylinder.

Window Sill Room Conditioner

HPAC 26**—American Stove Co., 1641 S. Kingshighway Blvd., St. Louis 10, manufacturer of gas ranges, is now producing a ¾ ton window sill type room air conditioner.

Styled in walnut finish, the unit is designed to cool, dehumidify, circulate, ventilate, and filter air in rooms having an area up to 400 sq ft.

Because of limited supplies, the unit is being introduced under a selective marketing plan in the southeastern and southwestern states only.

WE HEAR THAT . . .

HOWARD COONLEY, a director and retired board chairman of Walworth Co., a director of Link-Belt Co., and a director and past president of the National Association of Manufacturers, was honored at the recent National Standardization Conference as the industrial executive who has contributed most to the country's economy through standardization. The occasion was the first award of the Howard Coonley Medal, established by the *AMERICAN STANDARDS ASSOCIATION*. He is now serving as conservation consultant with the National Security Resources Board.

REYNOLDS METALS CO., Louisville, Ky., is building an $80 million aluminum reduction plant in the Corpus Christi area which will have the capacity to produce 150,000,000 lb of aluminum pig annually. Operation is expected to begin by the end of the year and about 600 people will be employed at this plant.

MINNEAPOLIS-HONEYWELL REGULATOR CO., has expanded the engineering personnel and departmental facilities of its valve division at Philadelphia by 400 percent. The expansion is part of a program which includes research into and development of new industrial valve designs.

For "making the most effective use of advertising space in business papers last year", *LADISH CO.*, Cudahy, Wis., was among the 52 winners of 800 entries in a contest sponsored by the Associated Business Publications. The award was presented earlier this month. *M. S. KACHIGAN* is advertising manager of the company and *R. F. BEERY* is the account executive of the agency, *CRAMER-KRASSELT CO.* The advertising was carried in HPAC.

A new Chicago district office has been established by *HAGAN CORP.*, Pittsburgh, and its subsidiaries, *HALL LABORATORIES, INC.*, *CALGON, INC.*, and *BUROMIN CO.* The office is located in the Monadnock Bldg., 53 W. Jackson Blvd. The corporation was formerly represented in Chicago by Burke & Colston.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has purchased the plant and equipment of *NATIONAL TRANSIT PUMP & MACHINE CORP.*, Oil City, Pa. Miscellaneous overflow from Worthington's other factories will be diverted to this plant which includes

WEBSTER
KINETIC* BURNER

For Low Pressure Gas

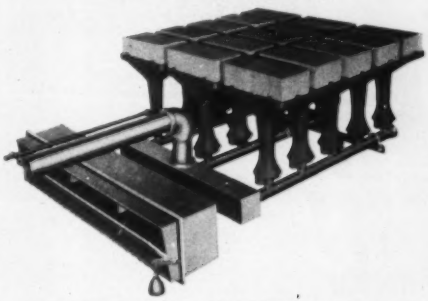
The Webster Kinetic consists of a multiplicity of full venturi mixers with flame retention nozzles. These are assembled in a metal casing complete with pilot and louvre. It may be used with natural, mixed or liquefied petroleum gases. Standby oil burners may be used when desired. As a multiple head assembly it is available in 25 standard sizes of from 4 heads to 48 heads, and can be supplied in any size or shape. Natural gas input ratings from 560,000 Btu/hr to 6,720,000 Btu/hr at 4" wc.

For complete information request Series B8 Bulletins.

●

WEBSTER
SERIES F 600 BURNER

For Low Pressure Gas



Designed for LOW GAS PRESSURE
INTERCHANGEABLE PORTS
RADIANT fire brick top
NO COMBUSTION CHAMBER required
Will NOT VIBRATE
LOW draft loss
ANY SHAPE and SIZE
INTEGRALLY MOUNTED pilots
*TRADEMARK

The WEBSTER ENGINEERING COMPANY
TULSA, OKLAHOMA
Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio

BASEBOARD RADIATION AT ITS BEST
...THAT'S BROWN BAYCE HEET
The Smart Looking Aluminum Fin Baseboard
• Smart looking, protrudes only 1⅛" from wall
• 615 B.T.U. per lineal foot with 170° average water temperature.
• Fins have amazing heat area due to exclusive beading process which provides greater radiation surface and durability.
• 5 ft. standard unit weighs only 12 lbs. . . requires only 3 simple wall brackets to install. Easily cut to any desired length.
• Closed top and open front prevent streaking wall.
• Removable front for easy cleaning.
Illustrated Brochure 4H on Request
Protrudes only 1⅛" from Wall
BROWN PRODUCTS COMPANY
FOREST HILLS, NEW YORK

an iron, steel, and brass foundry, a pattern shop, and a forge shop, machine shops, an assembly floor, test facilities, etc.

E. F. DREW & CO., INC., New York 10, N. Y., is conducting its series of water courses in New Haven, Conn., the 10th, 17th, and 24th of this month. Meetings will be held in the Mason Laboratory of Mechanical Engineering, Yale University. Classes consist of a series of discussions on various phases of water treatment.

Plans are now under way for the construction of a seamless tube mill at the South Chicago works of *REPUBLIC STEEL CORP.*, Cleveland. The mill will enable the company to produce in excess of 150,000 tons of seamless tubular products per year, and it is expected to be in operation by April 1952.

The 1950 sales of *IRON FIREMAN MFG. CO.*, Cleveland, climbed to $16,850,102 — the highest peak in its peacetime history. This is a 40 percent increase over 1949 and topped the previous record year of 1948, when sales totaled $13,227,167. According to the company, the increase was due primarily to substantial gains in the sales of gas and oil heating equipment.

TRION, INC., McKees Rocks, Pa., is in the process of an extensive expansion program covering both its organization and facilities..... Recently 12 foreign students from nine different countries and four continents were presented with graduation certificates by *WORTHINGTON PUMP AND MACHINERY CORP.*, Harrison, N. J. These students, who are graduate engineers, completed a four months' training course.

In a move necessitated by expanding operations, *UNITED STATES AIR CONDITIONING CORP.*, Minneapolis, has leased approximately 40,000 sq ft of industrial space in the Twin Cities for manufacturing and storage facilities..... *PYLE-NATIONAL CO.*, Chicago, has completed construction of two new additions and building changes to its main manufacturing plant. The new facilities are expected to substantially increase manufacturing, maintenance and warehousing operations.

DIAMOND IRON WORKS, INC., Minneapolis, has purchased the "Stokol" line of stokers from *AIRTEMP DIV., CHRYSLER CORP.* The purchase was made to offer better service to distributors and dealers and to expand existing distribution outlets. The name "Diamond Stokol" will identify all future merchandising efforts on behalf of Diamond stokers.

CENTURY ELECTRIC CO., St. Louis, has moved its branch office from Rochester, N. Y., to 814 Syracuse-Kemper Bldg., 224 Harrison St., Syracuse, N. Y. The move was made to better serve customers in the Rochester-Syracuse area. *LLOYD H. DOWNING*, district sales manager, is in charge of the office.

Principles of Automatic Control is a 16 mm sound and color movie prepared by the *INSTRUMENT SOCIETY OF AMERICA*, 921 Ridge Ave., Pittsburgh 12. With a

running time of 55 min, it is one of the society's educational projects and is designed to help students, technical personnel, instrument mechanics, production supervisors and operators. It is available for engineering groups, schools, etc.

A new series of educational shows, offered by *PENN ELECTRIC SWITCH CO.*, Goshen, Ind., as a service to heating and refrigeration engineers and servicemen, begins in Memphis the 9th of this month and travels throughout the southern and southeastern states. This show was created to give a dramatic visual demonstration in the use, construction, installation, and servicing of automatic controls.

SCHUTTE AND KOERTING CO. has moved its offices and plant to Cornwells Heights, Bucks County, Pa. The new facilities are located about 20 miles from Philadelphia.....*CONOFLOW CORP.*, Philadelphia, has appointed *J. R. SIMPSON & CO.*, 600 S. Michigan Ave., Chicago, a new representative operating in Illinois, Indiana, and Wisconsin.

GEORGE F. BERTRAND CO., 12 S. 12th St., Philadelphia, is the new exclusive representative in eastern Pennsylvania, southern New Jersey, and Delaware for *BALTIMORE AIRCOIL CO., INC.*, Baltimore. *G. V. SUTFIN CO.*, 4267 Delridge Dr., Cincinnati, is now exclusive representative in southwestern Ohio, northeastern Kentucky and southeastern Indiana.

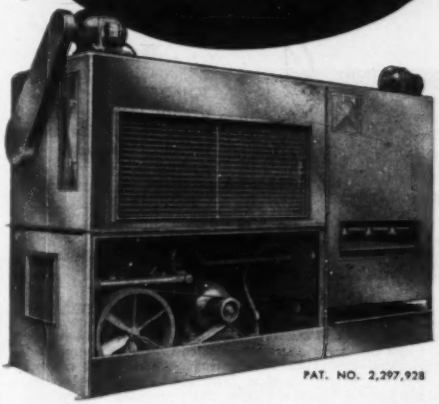
A new series of week-long classes for men in the metal industries is now under way and is sponsored by the educational department of *EUTECTIC WELDING ALLOYS CORP.*, 40 Worth St., New York 13. Remaining classes are scheduled to start the 16th of this month and the 14th of next month. Instruction includes practical applications in the joining, welding, brazing, overlaying, and cutting of virtually all metals.

COAST PIPE AND SUPPLY CO., San Francisco and San Jose, Calif., is a newly named jobber for *C. A. DUNHAM CO.*, Chicago, and will serve the central California area. *TAY-HOLBROOK CO.*, San Francisco, with branch offices in Oakland, Sacramento, Fresno, San Jose, Stockton, Santa Rosa, and Berkeley, has been appointed a stocking jobber and will cover the central and northern California area.

The new Dunham sales representative for Louisiana and southern Mississippi is *SOUTHERN HEATER CORP.*, New Orleans..... *T. J. O'BRIEN ENGINEERING CO.*, Memphis, Tenn., has been active in refrigeration and air conditioning engineering since 1930. The firm is now representing *ACME INDUSTRIES, INC.*, Jackson, Mich.

The new industrial and electronic sales representative in the Kansas City area for *WARD LEONARD ELECTRIC CO.*, Mt. Vernon, N. Y., is *MAURY E. BETTIS CO.*, 3319 Gillham Rd., Kansas City 3, Mo..... *AMERICAN COOLAIR CORP.*, Jacksonville, Fla., is "mobilizing for defense" through an expanded training program designed to familiarize dealers and distributors with applications of company products.

For day in, day out
DEPENDABILITY
you can't beat a
GOVERNAIR
COMPLETELY PACKAGED
AIR CONDITIONER

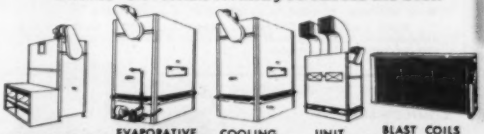


PAT. NO. 2,297,928

Name your job . . . any air conditioning job requiring from 3 to 50 tons . . . and you'll find that you can't beat a Governair system for day in, day out dependability.

Governair Packaged Air Conditioners are designed to operate at peak efficiency—with all parts precision-matched to work together. And they're built to give years and years of low-cost, trouble-free service.

Choose Governair . . . and you choose the best!

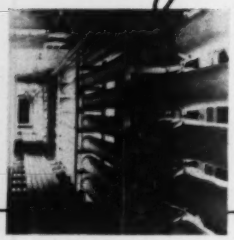


AIR CONDITIONERS | EVAPORATIVE CONDENSERS | COOLING TOWERS | UNIT COOLERS | BLAST COILS FOR HEATING AND COOLING

GOVERNAIR

ENGINEERED
for tomorrow

. . . **Badger** EXPANSION JOINTS . . . assure long, trouble-free life . . . an engineering masterpiece



Leading utilities are erecting ultra-modern power plants which are both *designed* and *engineered* for tomorrow. The structures represent the very latest trends in functional design . . . and the steam distribution systems must be engineered to perform with maximum efficiency. As you would expect, Badger Corrugated Packless Expansion Joints, constructed to the famous Directed-Flexing Self-Equalizing design are first choice with these forward-looking utilities.

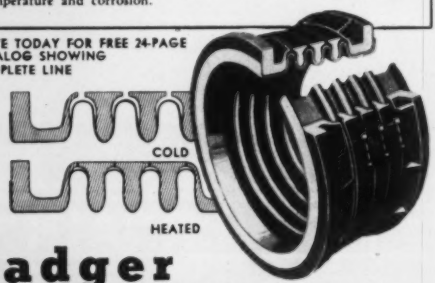
* * * * * *

What's the reason you find Badger Expansion Joints specified on *important* jobs? Because engineers have learned from years of experience to put their faith in the performance of Badger Joints . . . performance that's a result of construction features like these:

- Directed-Flexing Self-Equalizing rings . . . progressively control the movement of the all-curve corrugations.
- Packless . . . pressure-tight single tube — requires no maintenance.
- Compact . . . approximately the size of flanged fitting.
- Special forming . . . no structure-weakening stresses.
- Controlled heat treating . . . assures long life.
- Wide range of traverse — pressure — temperature.

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel or alloys to withstand high pressure, temperature and corrosion.

WRITE TODAY FOR FREE 24-PAGE CATALOG SHOWING COMPLETE LINE



Badger
MANUFACTURING COMPANY
230 BENT STREET, CAMBRIDGE, MASS.

WHO'S WHAT

LADISH CO., Cudahy, Wis., has appointed *E. O. DIXON*, well known metallurgist with the company for over 20 years, vice president in charge of research and metallurgy, and *T. L. SWANSEN*, general superintendent since 1949, vice president in charge of manufacturing.

WALTER SCHLICHTING, Young Radiator Co., has been elected president of the *CONVECTOR MANUFACTURERS ASSOCIATION*. He succeeds *J. HOWARD SMART*, of Tuttle and Bailey, Inc. *W. R. McMAHON*, of Modine Mfg. Co., has been elected secretary of the association, of which he is former president.

COLA G. PARKER, president and director of Kimberly-Clark Corp., has been elected to the board of directors of *CARRIER CORP.*, Syracuse, N. Y., filling the vacancy created by the retirement of *E. T. MURPHY*, senior vice president and one of the six original founders of the company. He continues to serve as a consultant and a director emeritus.

FREDERICK W. THOMAS, formerly general manager of purchases for Worthington Pump and Machinery Corp., is now director of purchases for *JOY MFG. CO. GEORGE R. FOX*, director of purchases for the company since 1949, is now assistant vice president in charge of the company's plant expansion program.

EDMUND FITZGERALD, president of Northwestern Mutual Life Insurance Co., has been elected a member of the board of directors of *ALLIS-CHALMERS MFG. CO.*, Milwaukee, filling the vacancy created by the recent death of *WALTER KASTEN*, former president of the First Wisconsin National Bank. *LOUIS QUARLES*, a director and general counsel since 1941, has been elected chairman of the executive committee. *FRANK R. HUNTER* has been named manager of the general machinery division's new office in Wichita, Kans. This office is being operated as a branch of the Kansas City district office.

DR. JOHN F. THOMPSON, president of *INTERNATIONAL NICKEL CO. OF CANADA, LTD.*, is now chairman of the board of directors, succeeding the late *ROBERT C. STANLEY*. *DR. PAUL D. MERICA*, executive vice president and a director, has been elected a member of both the executive and advisory committees.

W. J. O'NEIL, former manager of the Chicago branch of *IRON FIREMEN MFG. CO.*, Cleveland, has been elected chairman of the board of directors and chief executive officer, succeeding the late *T. H. BANFIELD*. He is succeeded in Chicago by *E. W. JONES*, former office manager in the branch.

Other newly elected officers include: *FRANK S. HECOX*, vice president, treasurer and a director; *C. T. BURG*, vice president in charge of sales; *E. C. WEBB*, vice president in charge of research and development engineering; *LEWIS J. COX*, vice president in charge of

public and employee relations; and *J. L. JENNINGS*, vice president in charge of operations.

E. M. MITTENDORFF, formerly of Chicago and whose address is now Red Apple Orchards, Shipman, Va., has been appointed director of utilities at the *UNIVERSITY OF VIRGINIA* and professor in the engineering graduate school.....Ed is also in charge of mechanical contracts for the university's $8 million expansion program.

Three newly elected executive vice presidents of *GENERAL ELECTRIC CO.*, Schenectady, N. Y., are: *HENRY V. ERBEN*, vice president of the company and general manager of the apparatus dept.; *HARDAGE L. ANDREWS*, vice president and general manager of the appliance and merchandise dept.; and *ROY W. JOHNSON*, vice president and general manager of the affiliated mfg. companies dept.

Four new vice presidents of *WESTINGHOUSE ELECTRIC CORP.*, Pittsburgh, are: *TOMLINSON FORT*, manager of the company's headquarters apparatus sales department; *L. W. McLEOD*, southwestern district manager; *EMERY W. LOOMIS*, middle Atlantic district manager; and *L. E. LYNDE*, manager of the New England district, but now heading the company's government office in Washington, D. C.

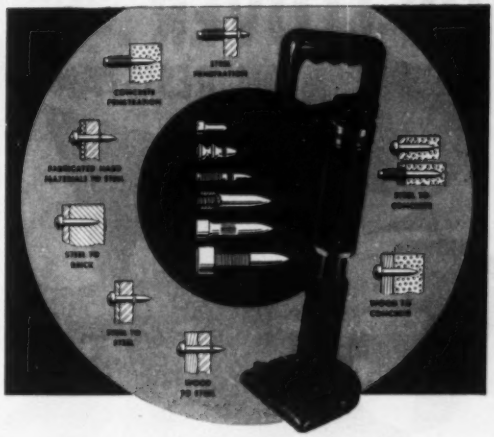
L. D. RIGDON, former manager of the headquarters manufacturing division of Westinghouse, has been named assistant to the vice president in charge of manufacturing. He is succeeded by *C. G. WALLIS*, formerly director of the headquarters manufacturing engineering dept.

A. B. DRASTRUP is now assistant to the president of *A. M. BYERS CO.*, Pittsburgh, also continuing in his position as manager of steel sales. *BUCKLEY M. BYERS*, former assistant manager of the New York office and manager of export sales, is now assistant manager of steel sales, and *VICTOR C. LAWRENCE* succeeds Mr. Byers as manager of export sales.

J. A. O'BRIEN, general manager of the industrial products division of *JOHNS-MANVILLE CORP.*; *HAROLD R. BERLIN*, general manager of the building products division; and *A. S. ELSENBAST*, general manager of the Celite division, are newly elected vice presidents. They all were formerly vice presidents of Johns-Manville Sales Corp., a subsidiary. They will take an active part in the work of the new overall planning board.

J. J. LLANSO, a vice president and manager of Worthington Ltd., Buenos Aires, Argentina, since 1947, has been appointed general export manager of *WORTHINGTON PUMP AND MACHINERY CORP.*, Harrison, N. J. *DAVID S. GIBSON*, in the general sales department since 1946, has been named assistant to the vice president, purchases and traffic.

A. WILLIAM FRASER, general European manager since 1945, has been appointed midwest sales manager of the company. *WILLIAM F. WEINREICH*, formerly



FINISH THE JOB SOONER WITH Ramset

You can do those fastening jobs into steel, concrete, masonry in jig-time when you put RAMSET SYSTEM to work. Taking less than a minute per fastener from start to finish, RAMSET often reduces time by as much as 90% . . . cuts costs in proportion.

With the widest range of sizes and types of fasteners, with graded power charges and with the strong, sturdy, reliable RAMSET TOOLS, you have an unbeatable combination to save time and money on most fastening jobs.

Ask for demonstration

If you haven't seen the improved RAMSET DUAL-ACTION TOOL in action, call your local RAMSET Specialist or write us for demonstration and proof. Takes only 15 minutes to learn for yourself how RAMSET will slash your costs and get your fastening work finished faster.

Ramset Fasteners, Inc.
12117 Berea Road
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Member of Producers' Council

Ramset Fastening System
Pioneer in powder-actuated fastening

TRI-CLOVER
...SION RESISTANT

Made to Perfection for Your Protection

FOR over 30 years Tri-Clover has supplied Industry with the finest and most complete line of stainless steel and alloy fittings, valves, pumps, tubing, pipe and specialties.

Benefit from this broad experience covering all types of liquid conveying line applications. Assure yourself of the highest performance by specifying *Tri-Clover.*

Industrial Centrifugal Pumps—Capacities up to 125 G.P.M. and up to 250 ft. head.
Butt welded fittings furnished in flanged assemblies. Ordinarily a "special" item, furnished as "standard" by Tri-Clover.
Sanitary Type Fittings — A full range of types, polished I. D. and/or O. D., from 1-in. thru 4-in. O. D. Includes many exclusive designs.
Stainless Steel Screwed Fittings and Valves—Precision cut threads to match standard I. P. S. piping.
"Zephyrweld" Welding Fittings—Fabricated in O. D. tube sizes ½ thru 24 in.
Recessed-End Fittings — Low cost, lightweight, in sizes ¾ in. thru 24 in.

Tri-Clover® MACHINE CO.
Kenosha, Wisconsin

Export Division—8 South Michigan, Chicago 3, U. S. A.

TRIALLOY AND STAINLESS STEEL SANITARY FITTINGS, VALVES, PUMPS, TUBING, SPECIALTIES

TRI-CLOVER THE Complete LINE

FABRICATED STAINLESS STEEL INDUSTRIAL FITTINGS AND INDUSTRIAL PUMPS

assistant superintendent of machine shops at the Buffalo plant, is now in charge of the company's newly acquired Oil City, Pa., plant, serving as assistant to Vice President *AUSTIN C. ROSS* who is in administrative charge of the plant.

MORRIS L. HICKS, sales manager of the engineering works division of *DRAVO CORP.*, Pittsburgh, is now manager of the Philadelphia district office..... *LEWIS P. FAVORITE*, who has been serving as product manager in charge of die casting sales for *ALUMINUM CO. OF AMERICA*, Pittsburgh, is now manager of the New York district sales office, succeeding *EDWARD B. WILBER*, newly elected president of American Lumber & Treating Co.

WALTER W. FINKE is now assistant director of the ordnance division of *MINNEAPOLIS-HONEYWELL REGULATOR CO.* He was formerly executive vice president of the Minneapolis Chamber of Commerce, and in his new position is in charge of negotiation and administration of the company's production contracts for the ordnance department.

DALE D. SPOOR, manager, equipment sales department, Air Reduction Sales Co., Div. of Air Reduction Co., Inc., has been granted a leave of absence to serve with the *NATIONAL PRODUCTION AUTHORITY* in Washington, D. C. As chief of the welding section of the NPA's machinery division, he heads the group to which all manufacturers of welding equipment will look for their requirements of critical materials.

NORMAN PRODUCTS CO., Columbus, Ohio, has appointed *DAVID A. RUEN* and *WILLIAM R. SUNDERMEYER* regional sales managers. Mr. Ruen was a manufacturer of gas water heaters in Detroit prior to becoming associated with Norman Distributors in the state of Michigan. His territory now consists of Michigan, Minnesota, Illinois, Iowa, Nebraska, North and South Dakota.

Mr. Sundermeyer will cover the states of Maine, Vermont, New Hampshire, Connecticut, Rhode Island, Massachusetts, New York, New Jersey, Pennsylvania, Delaware, Maryland, and Virginia. Before joining the firm, he was affiliated in a sales capacity with Paco Products, Inc., a Norman distributor.

FAIRBANKS, MORSE & CO., Chicago, has advanced *T. E. WOODRUFF* from assistant manager to manager of its pump division, with headquarters in Chicago. He succeeds *D. T. JOHNSTONE* who assumes the duties of pump department manager in the San Francisco branch. Mr. Woodruff has been associated with the company since 1912.

D. ROBERT YARNALL, president of Yarnall-Waring Co., has been awarded honorary membership in the *ENGINEERS' CLUB OF PHILADELPHIA*. There have been only 25 such memberships awarded in the 73 years of the club's existence. ..... *BRYANT HEATER DIV., AFFILIATED GAS EQUIPMENT, INC.*, Cleveland, has promoted *WILLIAM H. WISE* to assistant director of

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS

L

TO MARK PROGRESS

...you know they are in to stay

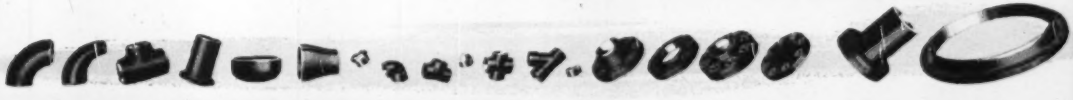
Long, trouble-free piping service results from extra safeguards in the manufacture of Ladish fittings. Rigid laboratory controls over chemical composition and physical properties of steel provide an assurance of maximum strength and resistance to erosion or corrosion. These are some of the extra safeguards for dependable operation which you always get in greatest measure in Ladish Controlled Quality Fittings.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

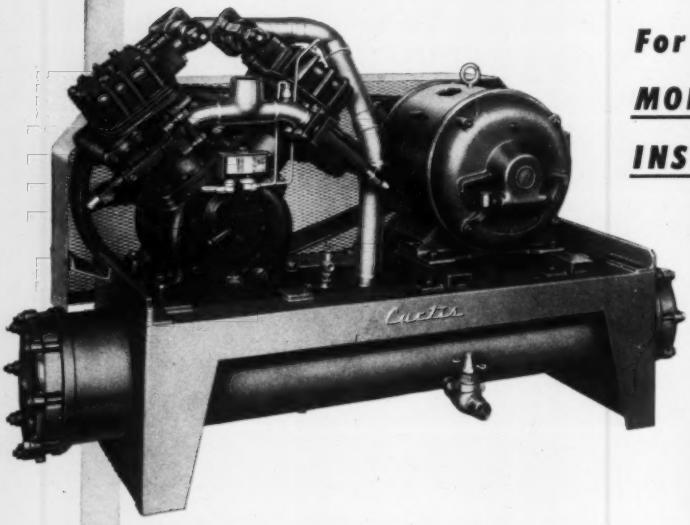
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • Havana • Toronto • Mexico City



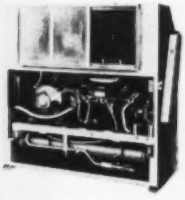
NOW A 40 H. P. CURTIS

WATER-COOLED CONDENSING UNIT



For LARGER, MORE PROFITABLE INSTALLATIONS

Packaged Type,
2, 4, 6, 8 Tons



Central Type,
10, 15 Tons

Some of the advanced design features that have made Curtis units so popular with the trade and the user in these larger models are:

- TIMKEN BEARINGS — LESS FRICTION — Easier adjustment.
- PRESSURE LUBRICATION — With low-pressure safety cut-out.
- SLOW-OPERATING SPEED — Economical — More capacity — Long Life.
- UNLOADED STARTING — 3-step capacity reduction

Complete range of condensers for any requirement.

With the broad Curtis line, you can handle all of the more profitable air conditioning and refrigeration installations. A limited number of franchises are open. Write giving full details.

97 Years of Successful Manufacturing

CURTIS REFRIGERATING MACHINE DIVISION

of Curtis Manufacturing Company

1950 Kienlen Avenue, St. Louis 20, Mo.

Curtis REFRIGERATION AIR CONDITIONING COMMERCIAL

R-51-3

Curtis

sales. For the past year he had been mid-western sales manager.

The board of directors of *AUTOMATIC SWITCH CO.*, Orange, N. J., has elected *W. F. HURLBURT, JR.*, president, succeeding *W. F. HURLBURT, SR.*, who is now chairman of the board. *MRS. H. V. DARRIN* continues as vice president with additional duties of secretary, and *DAVID M. DARRIN*, treasurer, is a new vice president.

At the recent annual meeting of the *INDUSTRIAL UNIT HEATER ASSOCIATION*, *J. C. PATTERSON* was re-elected president, *H. S. WHELLER*, vice president and *L. O. MONROE*, secretary-treasurer. Mr. Patterson is director of sales, industrial heating, Carrier Corp., and Mr. Wheller is president of the L. J. Wing Mfg. Co.

The new advertising and sales promotion manager for *DAY & NIGHT, DIV., AFFILIATED GAS EQUIPMENT INC.*, Monrovia, Calif., is *GENE MacFARLAND*. He was formerly with the Kaiser Co., Grove Laboratories, and A. C. Nielsen Co..... *GEORGE F. GILFRIN*, Mexico City, is now the exclusive representative throughout Mexico for *TRION, INC.*, McKees Rocks, Pa. He is a well known heating engineer in Mexico with over 20 years of experience in this field.

HARRY WINTER and *KARL W. RAUSCH* are new members of the engineering staff of *VIKING AIR CONDITIONING CORP.*, Cleveland. Mr. Winter, who will be active in the company's military production program, was formerly with several manufacturers of electric motors in supervisory engineering capacities. Mr. Rausch will take charge of engineering and expansion of the company's tool and plant facilities. He was formerly with Perfection Stove Co. and later became chief engineer for Hackney Brothers Body Co.

ORREN S. LESLIE, formerly plant manager of the Electro-Motive Div., General Motors Corp., is now manager of the Beloit, Wis., works of *FAIRBANKS, MORSE & CO.*, replacing *HENRY M. HAASE* who has resigned.

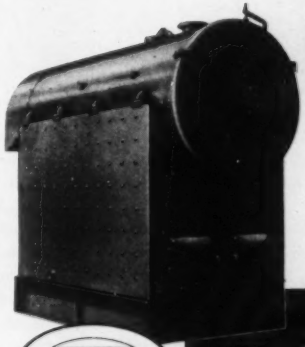
HERBERT B. NECHEMIAS is the new manager of the Industrial Sales Dept., *WAGNER ELECTRIC CORP.*, St. Louis, succeeding *J. S. SMITH* who is now director of purchasing. Mr. Nechemias spent 12 years in the sales department prior to his promotion.

GEORGE J. READ, formerly general manager for *CHELSEA FAN AND BLOWER CO., INC.*, Plainfield, N. J., is now vice president of the company. *LESLIE R. HANSEL*, newly elected vice president in charge of manufacturing, was formerly production superintendent. *HENRY W. CLOWER* has been advanced from southern sales representative to vice president in charge of southern operations. *T. B. ALLEN*, well known for his engineering and sales activities in the electrical industry, is the company's new mid-western representative.

The 1951 Frank Newman Speller Award, given for contributions to corrosion engineering, has been awarded to *KIRK H. LOGAN*, research engineer of the Cast Iron

Enjoy
EASY BOILER REPLACEMENT
in tough entry conditions!

TITUSVILLE "Compact"
SPLIT FIREBOX
Boilers



Left: Assembled view of Titusville "Compact" Split Firebox Boiler.

TITUSVILLE IRON WORKS CO TITUSVILLE, PA.

Right: The Titusville "Compact" Split Firebox Boiler with sections opened, suggesting ease of manipulation.

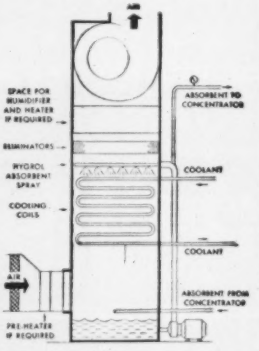
For replacement installations where entrance conditions are not sufficient for the standard boiler, Titusville "Compact" Steel Boilers are obtainable in split firebox design. This practical expedient permits passage of the boiler in unit sections through narrow openings, with easy reassembly. Send us your replacement problem, and let us recommend the best solution for you! Request Bulletin Form C-7959 for Clearance Dimensions.

THE TITUSVILLE IRON WORKS COMPANY
A division of Struthers Wells
TITUSVILLE, PENNSYLVANIA

How You Save with the NEW Niagara Method of Air Conditioning

Using "Hygrol" Absorbent Liquid

Because it absorbs moisture from the air directly, the new Niagara Controlled Humidity Method uses less, or no, mechanical refrigeration for dehumidifying. You save first costs and installing of heavy machinery. You save space, maintenance expense, power. Easier, convenient operation.

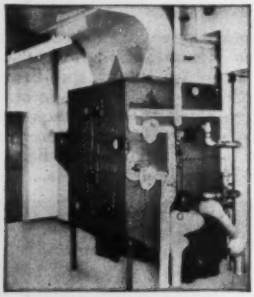


NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

Using "Hygrol" hygienic absorbent liquid, this method gives complete control of temperature and relative humidity. Especially, it is a better way to obtain dry air for drying processes, packaging hygroscopic materials, preventing moisture damage to metals, and obtaining better quality for chemical process products and food products—or in obtaining better results in comfort air conditioning for office or laboratory at lower refrigeration costs.

The diagram shows how filtered air is dehumidified by passing thru a spray of "Hygrol"— a liquid absorbent which removes air-borne moisture. This liquid is hygienic and non-corrosive; it contains no salts or solids to precipitate and cause maintenance troubles. It is continuously reconcentrated at the same rate at which it absorbs moisture, providing always the full capacity of the air conditioner, automatically.

Food Packaging under Controlled Humidity


Niagara Controlled Humidity Air Conditioner

Units provide a range of capacities from 1000 to 20,000 C. F. M. Multiple unit installations are in use successfully. Records of results are available.

For further information, write to Niagara Blower Company, Dept. HP, 405 Lexington Ave., New York 17, N. Y.

Pipe Research Association. *H. H. UHLIG*, head of the corrosion laboratory at Massachusetts Institute of Technology, has been awarded the 1951 Willis Rodney Whitney Award. The awards are given yearly by the *NATIONAL ASSOCIATION OF CORROSION ENGINEERS.*

RALPH KAY CRANDALL has joined the engineering and construction firm of *C. F. BRAUN & CO.*, Alhambra, Calif., as a consultant on mechanical problems of the petroleum and petro-chemical industries. He was formerly chief engineer for Beiswenger and Hoch..... *P. I. BOHMANN*, regional manager, U. S. Machine Corp., has been elected president of the *MIDWEST STOKER ASSOCIATION*, succeeding *F. H. HERNDON*, president, Herndon Sales & Service Co.

E. J. WORLEY, the new MSA vice president, is head of Stoker Service Co., and *E. M. MAY*, the new secretary-treasurer, is Chicago branch manager for Steel Products Engineering Co. *J. J. HAYES*, Auburn Stoker Co., and *JOSEPH J. ZANG*, vice president, Herndon Sales & Service Co., will serve as directors, along with the three new officers.

DONALD A. CAMPBELL has joined *ECLIPSE FUEL ENGINEERING CO.*, Rockford, Ill., as vice president in charge of engineering and research. He was formerly manager of the industrial division of Bryant Heater Div., Affiliated Gas Equipment, Inc. *CHARLES F. BISHOP*, formerly with W. S. Rockwell Co., is the new representative for the northern section of Texas and all of Oklahoma.

S. B. APPLEBAUM has been named manager of the water treatment division of *COCHRANE CORP.*, Philadelphia. He joined the firm in 1949 and has been manager of the cold process section of the division.

GEORGE M. HASE is a new sales representative for *L. J. MUELLER FURNACE CO.*, Milwaukee. Working under the supervision of *HARRY B. McKEE*, northern district sales manager, his territory will include North Dakota, South Dakota, Minnesota and northern parts of Wisconsin and Michigan. He has been with the company since 1948, most recently in the Milwaukee city sales department.

The newly elected officers of the *REFRIGERATION AND AIR CONDITIONING CONTRACTORS ASSOCIATION OF CHICAGO* are: President — *HARRY L. BRANSKY*, Bransky Refrigeration Co., Vice President — *B. J. PRUYN*, Refrigeration Service Co.; Secretary-Treasurer — *EARL A. McLEAN*, Merchants Commercial Refrigeration Engineering Sales.

ALAN W. ABEGGLEN has been appointed to the Beaver Falls district sales office of *BABCOCK & WILCOX TUBE CO.*, Beaver Falls, Pa. Since 1945 he has been in the general sales office of the company's welded tube division. *DAVID W. JONES, JR.*, is the new sales agent in the Rocky Mountain area for the company. He has been a sales representative in this area for a number of prominent steel and steel product manufacturers.

UTICA RADIATOR CORP., Utica, N. Y., has named *THOMAS G. JONES*, sales representative in the New England states, except for Connecticut. He has been with the company for nearly 20 years and has succeeded *T. W. GLADWIN*, who has retired.

Six newly appointed field engineers for *AIRTEMP DIV., CHRYSLER CORP.* are: *ROBERT S. AMBROSE*, serving Dallas; *OLE A. CHRISTENSEN*, Dayton; *ROBERT L. KING*, Chicago; *RALPH J. LINK*, Philadelphia; *PAUL R. LINT*, Washington, D. C.; and *WILLIAM F. WALTER*, Atlanta, Ga. All have recently completed a company training program and are veterans of World War II.

GILBERT HAM has been assigned to the Detroit branch sales office of *NATIONAL RADIATOR CO.*, Johnstown, Pa. He was recently affiliated with a heating equipment manufacturer as assistant manager of the unit heater and convector division.

Six members of the *ARMSTRONG CORK CO.'s* building materials division industrial products sales training class have completed their course and have been assigned to district offices. They are: *WILLIAM H. BURNETT* to St. Louis; *GEORGE E. DABNEY* to Dallas; *JAMES M. DeMOTT* to Baltimore; *JAMES E. JOHNSON* to Pittsburgh; *JOHN A. KUHNEN* to Chicago; and *JOHN U. WEBER* to Kansas City.

HAROLD J. BARTLETT is the new sales manager for *ALLOY STEEL PRODUCTS CO.*, Linden, N. J. He was formerly manager of alloy sales for Crane Co. ..... *RUTH I. SHAFER* is the new eastern division manager of *OVERHEAD HEATERS, INC.*, New York. From the company's new headquarters at 521 Fifth Ave., New York, she will be in charge of sales in the eastern seaboard states from Maine to Florida.

RICHARD D. LEMMERMAN has been appointed vice president in charge of engineering, research and development for *INDUSTRIAL SOUND CONTROL, INC.*, Hartford. Conn. He is also serving as a member of the board of directors and has been with the company off and on for the past five years in various engineering capacities.

FRED B. MERRITT, formerly divisional sales manager, United States Air Conditioning Corp., has been named midwest sales manager for *SCHNACKE, INC.*, Evansville. Ind. He will direct activities of some 26 factory representatives in the principal cities of his territory. He has been with the firm a year.

RUSSELL T. TREE, along with *CHARLES E. NORTH, JR.*, has taken over the Frigidaire franchise in Essex and Union Counties in New Jersey, and *SHERMAN LOUD* has been appointed general manager of *MAINCO AIR CONDITIONING AND REFRIGERATION CORP.*, an affiliate of the Maintenance Co., Inc., New York.

GEORGE E. WEEKS, sales manager since 1944 and a director for the past five years of *AMERICAN COOLAIR CORP.*, Jacksonville, Fla., is now vice president of the firm.

NEW!

AGITAIR® METER

for

ACCURATE MEASUREMENT OF AIR VELOCITIES

Here's the new AGITAIR Meter—a compact, portable, battery powered air velocity measuring instrument especially designed for heating, ventilating and air conditioning engineers.

Based on the hot thermopile principle, the AGITAIR Meter gives instantaneous accurate measurements of air velocities as low as 5 fpm, and as high as 4000 fpm. It is inherently stable, does not waver or jerk and unlike many resistance type hot-wire instruments it is free from errors caused by temperature variations, radiation effects and lead resistance. For taking static pressure readings from 0 to 4" wg, a special attachment is provided.

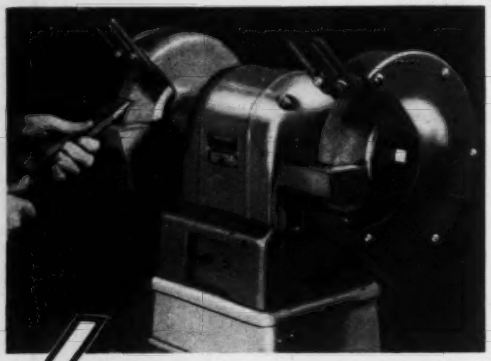
Low Velocity Range: 0-750 fpm
High Velocity Range: 750-4000 fpm
Pressure Range: 0-4 inches water

The simplicity and utility of the AGITAIR Meter make it useful for many diverse applications.

Write for Complete Data

AIR DEVICES Inc.
17 East 42nd Street | New York 17, N. Y.
Air Diffusers • Air Filters • Roof Exhausters

4 B&D BENCH GRINDERS—6" to 10" wheel diams. Standard and Heavy-Duty models—from **$42.00**



4 ways to CUT GRINDING COSTS!

BLACK & DECKER BENCH GRINDERS give you the *right* tool at the *right* price, whether you need a Bench Grinder for occasional or continuous use! They'll speed up your tool sharpening; grind pipe, rings, connections, fixtures; wire brush, buff, burnish, polish and finish sheet metal; remove saw or shear burrs and weld marks. Their modern design gives you more working clearance. Their dependable B&D-built "constant speed" motors maintain correct operating speed. Their high-quality parts are *built to last*, give you more work for your money! See your nearby B&D Distributor for a demonstration. Write for free catalog to: THE BLACK & DECKER MFG. CO., 628 Pennsylvania Ave., Towson 4, Maryland.

Buy These Other Black & Decker Tools for Faster Work on Many Jobs!

4 B&D ELECTRIC HAMMERS *rated by drilling capacity in concrete from 1/2" to 2".*

25 B&D ELECTRIC DRILLS *from 1/4" to 1 1/4" capacity.*

3 B&D ELECTRIC PORTO-SHEARS* *in 18, 16 and 12-gage capacities.*

25 B&D SCREW DRIVERS *for wide range of screw driving and nut running.*

4 B&D ELECTRIC SANDERS *7" and 9" disc diams.*

LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker PORTABLE ELECTRIC TOOLS

*Trade Mark Reg. U. S. Pat. Off.

NEW BOOKS & REPORTS

New Safety Code Gives Ventilation Requirements for Plating, Other Tanks

To protect workmen from escaping gas, vapor, or mist involved in open-surface tank operations, the American Standards Association has approved and published American Standard Safety Code for Open-Surface Tanks, Z9.1-1951.

Operations involving the immersion of materials in liquids and their subsequent removal are covered in this code. These include electroplating, washing, anodizing, pickling, quenching, dyeing, dipping, tanning, dressing, bleaching, degreasing, alkaline cleaning, stripping, rinsing, and digesting.

The safety of the operator is the primary concern of this standard. The provisions are intended to protect him from contact with gases, vapors, mists, or liquids involved in any open-surface tank operation that might injure his health.

The standard classifies open-surface tank operations into 12 classes depending upon the relative need for controlling the gas, vapor or mist rising from the tank. Tables are included to allow classification of any open-tank operation from a knowledge of the tank temperature; the boiling point, flash point and relative evaporation rate of the liquid in the tank; the maximum allowable concentration in the air of the vapor or mist produced; and the extent that the operation produces mist. Ventilation requirements vary with the need for control as indicated by the classification of the operation.

The standard stipulates for each "class" a minimum control velocity for enclosing hoods with one or two open sides; for canopy hoods with three or four open sides; and for lateral exhaust with no hood over the tank. The procedure is also outlined for computing the ventilation rate (in cfm) required to maintain the necessary control velocity for each hood type and includes a number of examples of these computations.

Rules on personal protection are included as well as rules on operation; inspection; maintenance and installation; special precautions for cyanide; and vapor degreasing tanks. Provision is made to allow the use of both control means other than ventilation, and methods of ventilation involving supplied as well as exhausted air. When an operation has both a low hazard potential and a low rate of gas, vapor or mist evolution, general room ventilation by either natural or mechanical means is considered safe and acceptable as the control means.

The appendix at the back of the code includes tables of the resistance to corrosion of materials used for hoods, ducts and exhaust fans, as well as seven pages of typical exhaust hood designs.

This standard is a revision and expansion of the American Standard for Safety in Electroplating Operations, Z9.1-1941.

Work on the new code was sponsored by the American Industrial Hygiene Association, the American Society of Heating and Ventilating Engineers, and the National Association of Fan Manufacturers.

Copies may be obtained from ASA headquarters, 70 E. 45 St., New York 17, for 75 cents.

Air Conditioning and Refrigeration Are Vital to Our National Economy

Of all contributors to the progress of America, few play as vital a part as the commercial and industrial refrigeration and air conditioning industry, both in time of peace and in time of war. This industry is a bulwark of our national economy and serves in countless essential ways to protect foods, health, and materials. A 40 page booklet, Refrigeration and Air Conditioning — Vital to America, briefly summarizes the principal contributions of the industry to the economy of the nation.

Leading off with a brief description of the part played in the food industry, the booklet then turns to industrial applications where refrigeration and air conditioning are used to increase production, to store and prepare raw materials, to improve quality, and to assure accuracy and close tolerances formerly unheard of outside the laboratory. Also discussed is the important role which the industry now plays in the fields of research and development. In laboratories throughout the country the control of temperature and humidity is a vital tool to the scientists who are searching to improve materials and to develop new and better products.

After indicating that refrigeration and air conditioning will have an indispensable part in civilian defense, particularly with respect to air raid shelters, the dispersion and protection of food and water supplies, the arranging of emergency hospitals, and the local stock piling of medical and other necessities, the booklet illustrates many military applications. These include bombsight storage and repair, celestial navigation, clothing storage, parachute drying and storage, aviation control towers, engine test buildings, Link-Trainer buildings, photographic development, plotting rooms, armament, fire control buildings, instrument repair buildings, naval vessels, etc.

Indicating the tremendous growth of the refrigeration and air conditioning industry, data are tabulated on the value of manufacturers' shipments (excluding household refrigerators and home freezers) for the years 1938 to 1950. In 1938 the value was $163,500,000. This rose to $306,100,000 in 1940 and dropped to $140,700,000 in 1942. The value of shipments increased somewhat in 1943 and then decreased slightly in 1944. Since then, however, the value has increased steadily to $639,000,000 for 1950.

The booklet is paper covered, contains 40 pages, and is available for $1.00 from the Air Conditioning and Refrigerating Machinery Association, Inc., Southern Bldg., Washington 5, D. C.

ASRE Issues New Data Book

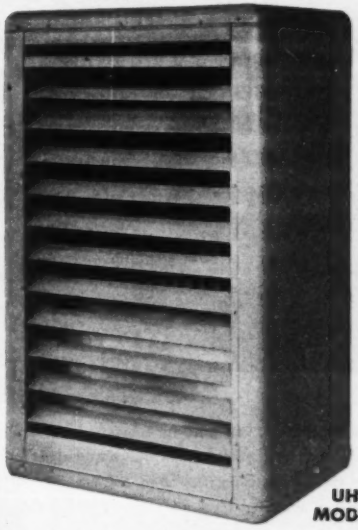
Refrigeration Data Book, Applications Volume (third edition), has been edited by D. C. McCoy, of Frigidaire Div., General Motors Corp., and is published by the American Society of Refrigerating Engineers.

This is the second revision of the volume first published in 1940 and revised in 1946. All chapters have been reviewed, revised and brought up to date by 81 authors. Several chapters have been completely rewritten to conform with the latest practices in refrigeration applications and, in addition, the volume has been expanded to include five new chapters, including one on metals for use at low

JOHN ZINK

UNIT HEATERS

Two Designs Available



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For clean, safe, trouble-free heating of industrial and commercial establishments, gas-fired suspended heaters have proven themselves and assure customer satisfaction. A complete, packaged unit fully automatic, the heaters are suspended from the ceiling to conserve valuable floor space and yet are designed so that they will be an attractive addition to any shop or store.

A.G.A. Approved for Natural, Mixed, Manufactured or LP Gas

UH-4 MODEL

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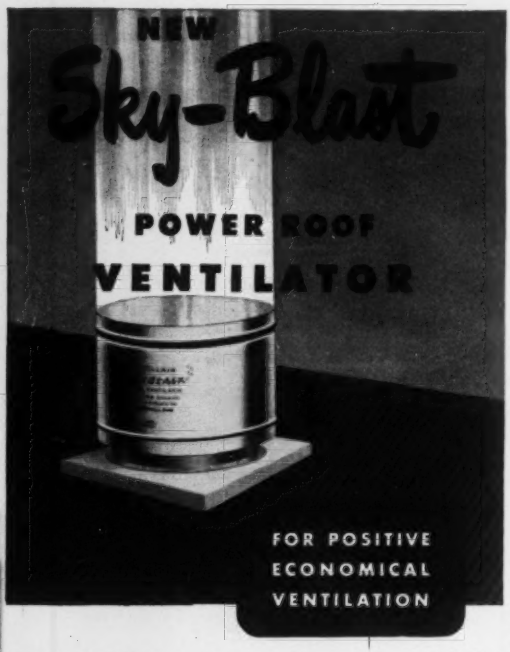

■ In roof ventilation, you need air movement—and plenty of it! The new Propellair Sky-Blast gives you powerful air movement at minimum cost. With capacities from 2800 to 78,800 CFM, its performance is amazing! Here are a few of its advantages:

Built to do a job

Sky-Blast design is strictly functional—no frills, no gadgets. A powerful suction sweeps up heat, moisture, dust fumes . . . and a strong exhaust shoots them high into the outside air. Performance is constant, regardless of wind direction or velocity!

Many new design features

You get many engineering refinements in the new Sky-Blast . . . including automatic butterfly dampers that will not leak, streamlined wind guard, and non-clogging rainshed. The heart of the Sky-Blast is the famous cast-aluminum airfoil propeller—powered by a fully enclosed, weather-resistant R & M motor.

Simplest installation

Sky-Blast units are designed for easy mounting on any roof. Their symmetrical, low silhouette gives pleasing appearance, low wind resistance, low roof stresses. Heavy-gauge, curb base gives lifetime support.

Write for catalog H-680-P—Propellair has fans of types, sizes and capacities to meet almost every industrial need. Let us study your air movement problem and submit recommendations. No cost or obligation.

PROPELLAIR
DIVISION OF ROBBINS & MYERS, INC.
SPRINGFIELD · OHIO

temperatures. Bibliographies are used throughout the book, providing sources of additional information. For locating subject matter more easily, the index has been enlarged to include more headings, subheadings, and cross references. The book is divided into eight major sections and, in addition to the new section on low temperature applications, some of the others deal with industrial applications, comfort air conditioning, and industrial air conditioning.

Copies of this 1080 page, clothbound book may be obtained from ASRE headquarters, 40 W. 40th St., New York 18, for $6.00.

ASTM Revises Standards on Copper, Copper Alloys

The latest edition of ASTM Standards on Copper and Copper Alloys includes the 108 standards of the American Society for Testing Materials which pertain to copper and copper-base alloy products and which were developed by its Committee B-5 and other technical committees. There is a section with 20 specifications on copper, copper alloys, and copper covered steel wire, rods, bars, and stranded conductors for electrical purposes; and following this is a group of 13 specifications covering various nonferrous metals such as slab zinc, copper, nickel, silicon copper, lead, and others. Then follows several sections containing 63 specifications on various copper and copper alloy products, such as plate, sheet, strip, wire, rods, bars, shapes, pipe and tubes, sand and die castings, arc welding electrodes and brazing solder. Also included in the compilation are 10 test methods covering expansion, mercurous nitrate, resistivity, tension, micrographs, hardness, sampling, and grain size evaluations.

This 542 page book can be obtained from ASTM headquarters, 1916 Race St., Philadelphia 3, for $4.35 with paper cover, $5.00 with cloth cover.

Offers Standardized Design for Theater Air Conditioning

According to G. B. Priester, air conditioning engineer, Consolidated Gas, Electric Light & Power Co. of Baltimore, and O. W. Armspach, New York district chief engineer, Carrier Corp., the basic calculations required for the design of air conditioning systems in theaters, auditoriums, assembly halls, etc., may be standardized more readily and with greater accuracy than for many other applications. In addition, a standardized method for determining equipment sizes, based largely on the number of occupants, has proved practical. This method is presented in their paper Air Conditioning in Theaters.

In discussing the cooling load, the authors point out that it includes heat from lights, heat transfer through building construction, heat from occupants, and heat in the outside air circulated by the system. Of these, only the first two vary with the building construction and design and are not a direct function of the number of occupants. The last two items are independent of building construction and are constant for a given outdoor and indoor design condition. The cooling load calculation is further simplified, according to the authors, by the fact that under maximum load conditions and design temperatures, the last two items account for approximately 87 percent of the total load. Because of these facts, they state that it is practical to determine the refrigeration

load on a per occupant basis by use of a chart, such as the one included in this paper which is based on 0.462 lb of outside air per min per occupant (6¼ cfm at 13.5 cu ft per lb).

Design precautions stressed by the authors indicate that the air distribution system should be designed to maintain a general air movement from front to rear at head level. Any movement at this level in the opposite direction will usually prove objectionable. At no time should air be exhausted from the lobby as this is likely to cause an inward movement through the entrance doors. To counteract the chimney effect, all air escape openings should be tightly closed. Direct radiation is required at all exit doors, on the stage, and in the entrances.

This paper is published by the American Society of Refrigerating Engineers, 40 W. 40th St., New York City, and is identified as Refrigerating Engineering Application Data Sheet 16-R. Copies may be obtained for 45 cents.

Short Method of Pattern Development

Short Method of Pattern Development, by Ralph W. Poe, sheet metal contractor, and published by Armco Steel Corp., Middletown, Ohio, was written especially for sheet metal workers. Requiring no knowledge of geometry, drafting, or mathematics, it explains the "rollation" method of layout.

Not only is this method fully explained, but the book describes how it is used to make many types of patterns required in sheet metal work. Sketches and photographs are used to explain the layout of square to round transitions, rectangular to round fittings, Y fittings, tee joints, angular joints, and other parts.

Copies may be obtained from the company for 30 cents. The pamphlet contains 52 pages, and is paper covered.

Other Books and Reports Received

INVENTORY CONTROL AND PRIORITIES, published by the National Production Authority—A 16 page booklet designed to answer those questions most frequently asked of NPA in respect to the application of its Regulations 1 and 2 to industry and business. According to the booklet, these are accurate answers to general questions, but they should not be considered as legal interpretations applicable to a specific case. More specific information and copies of the booklet may be obtained from your nearest NPA field office.

MATHEMATICAL ENGINEERING ANALYSIS, by Rufus Oldenburger, of Woodward Governor Co., published by Macmillan Co., 60 Fifth Ave., New York 11, and priced at $6.00—This 426 page book assumes a knowledge of advanced calculus and is not intended to supplant advanced courses in mathematics and applied sciences. The book is intended to serve as a text in courses on engineering analysis and industrial physics and as a reference work for research directors in industry, for engineering analysts, for development engineers, and for applied scientists in various fields of learning. It is the outgrowth of lectures given by the author at Illinois Institute of Technology and at De Paul University. Emphasis is on setting up engineering problems in mathematical form, and the text covers mechanics of rigid bodies, electricity and magnetism, heat, elasticity, and fluid mechanics.

DOLE *Ice-Cel* INSTALLATION

"an answer to prayer"

says BAPTIST PASTOR

Ice-Cel unit — the storage battery of refrigeration.

Two years ago Winstanley Baptist Church of East St. Louis, Illinois, installed in their church basement a DOLE Ice-Cel system using three DOLE units. The installation, made by Gram Refrigeration Co. of that city, has given year round comfort not only to the congregation of 1,200 but to the Young People's Class of 75. "Aside from having a well regulated temperature in our auditorium the year round," writes Pastor Purdue, "we are enabled to keep our windows and doors closed in the summer which eliminates noise and mosquitoes."

DOLE Ice-Cels are the answer in **every** type of air conditioning not only for churches but for cafeterias, lodge halls, mortuaries, office buildings and retail stores where the load is of short duration and the Ice-Cels can be charged during off-peak hours with a smaller, less costly condensing unit. Write for Bulletin 8-ES which gives complete data on this new and important air conditioning system.

DOC DOLECO says —

A lot more people would attend a lot more churches a lot more of the time if they could enjoy the comfort of Ice-Cel air conditioning.

DOLE Vacuum COLD PLATES — REFRIGERATION PURPOSES

DOLE Refrigerating Company

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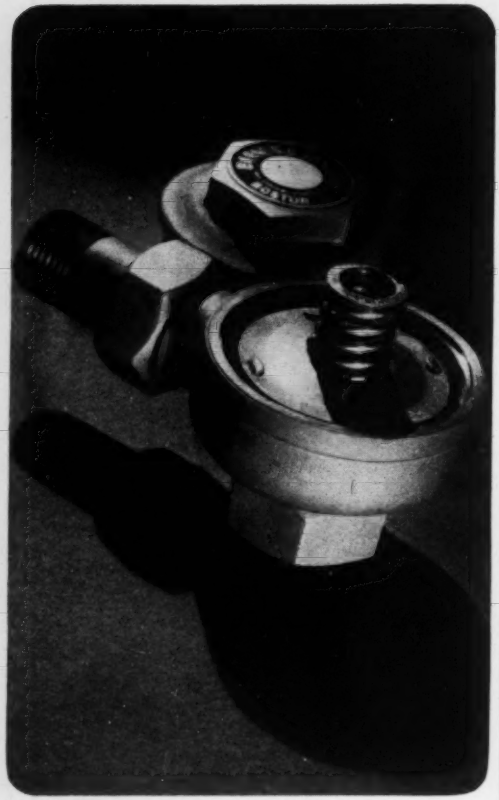
103 Park Ave., New York 17
44 Elgin St., Brantford, Ont.



This Trap Makes a Habit of Real Thrift

Built to last, a B&J Trap is a miser on maintenance. The cage unit is a complete operating unit in itself, containing the thermostatic element, valve piece and trap seat accurately calibrated in exactly correct relation to each other before it leaves our factory . . . and locked in permanent, unalterable adjustment. This reflects in real savings on repair and maintenance problems after installation.

Yes, when you select Barnes & Jones heating specialties in the beginning, you never have regrets in the end!

B&J

BARNES & JONES, Inc.
128 BROOKSIDE AVENUE, BOSTON 30, MASS.
Representatives in all principal cities

MEETINGS & CONVENTIONS

AMERICAN FOUNDRYMEN'S SOCIETY, 616 S. Michigan Ave., Chicago 5—The 55th annual convention will be held in Buffalo, N. Y., April 23 to 26.

I-B-R SCHOOL OF MODERN HEATING, sponsored by the Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17.—This is a traveling school designed to provide an intensive three-day training in heating design and installation. Classes will be held this month in Chicago, Ames, Ia., and Evansville, Ind. Classes will be held next month in Cincinnati, Columbus, Ohio, and Cleveland. Additional information may be obtained from the institute.

MATERIALS HANDLING EXPOSITION—International Amphitheater, Chicago, April 30 to May 4. Industries which will be given special attention in exhibits include paint and varnish, oil, chemicals, and food processing. Simultaneously with the show, which is sponsored by the Material Handling Institute, a three-day conference will be conducted by the American Material Handling Society. Additional information may be obtained from the show manager, Clapp and Poliak, Inc., 341 Madison Ave., New York 17.

AIR POLLUTION AND SMOKE PREVENTION ASSOCIATION OF AMERICA—The 1951 annual meeting will be held May 6 to 10, Roanoke, Va.

HEATING, PIPING & AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION, 1250 Avenue of the Americas, New York 20—The 62nd annual convention, Shoreham hotel, Washington, D. C., May 8 to 11.

AMERICAN INSTITUTE OF ARCHITECTS, Washington 6, D. C.—The 1951 convention and national seminar meetings will be held May 8 to 11, Edgewater Beach hotel, Chicago. For the first time in 83 years a product exhibition will be held in conjunction with the affair. According to the institute, only those building products or methods recently placed in production or shortly to be offered commercially will be granted space.

ENGINEERING INDUSTRIES EXHIBITION—To be held in conjunction with the silver anniversary convention of the New York State Society of Professional Engineers, May 10 to 12, Hotel Statler, New York City. Additional information may be obtained from the chairman of the society's exposition committee, 1941 Grand Central Terminal, New York 17.

NATIONAL ASSOCIATION OF BUILDING OWNERS AND MANAGERS, 134 S. La Salle St., Chicago—The 44th annual convention will be held May 20 to 24, Houston, Tex.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, 40 W. 40th St., New York 18—The 38th spring meeting will be held at the Hotel Statler, Detroit, May 27 to 30.

NATIONAL DISTRICT HEATING ASSOCIATION, 827 N. Euclid Ave., Pittsburgh 6—The 42nd annual meeting will be held June 5 to 8 at the Statler hotel, Detroit.

AMERICAN SOCIETY FOR TESTING MATERIALS, 1916 Race St., Philadelphia—This year's annual meeting is scheduled for June 18 to 22 at Chalfonte-Haddon Hall, Atlantic City.

STOKER MANUFACTURERS ASSOCIATION, 307 N. Michigan Ave., Chicago 1—The annual meeting will be held at the South Shore Inn, Lake Wawasee, Syracuse, Indiana, on June 25 and 26.

EIGHTH INTERNATIONAL CONGRESS OF REFRIGERATION—To be held in London, England, August 29 to September 11. Additional information may be obtained from the secretary of the conference, Dalmeny House, Monument St., London, E. C. 3.

6th NATIONAL INSTRUMENT CONFERENCE AND EXHIBIT—Sponsored by the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12. The affair will be held in the Sam Houston Coliseum, Houston, Tex., September 10 to 14.

INTERNATIONAL DISCUSSION OF HEAT TRANSFER—Postwar heat transfer developments will be the theme of a meeting, September 11 to 13, London, England. Plans for participation by engineers in the western hemisphere are being arranged by a joint committee on North American participation, which consists of representatives from some 12 professional and engineering societies. The American Society of Mechanical Engineers is coordinating administrative details.

BRITISH BUILDING RESEARCH CONGRESS—Sponsored by a number of professional institutions and societies, government departments, and representative industrial federations, the congress will be held in London, September 11 to 20. Additional information may be obtained from the organizing secretary, Building Research Congress 1951, Building Research Station, Bucknalls Lane, Garston, Watford, Herts, England.

Among the papers to be presented during the heating and ventilating sessions is one on heat transfer, by Prof. C. O. Mackey, Cornell University, and one on radiant heating by Prof. F. W. Hutchinson, University of California.

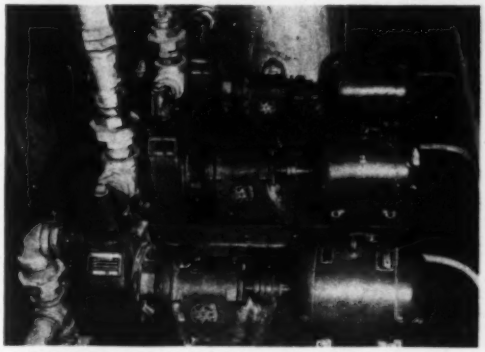
AMERICAN GAS ASSOCIATION, 420 Lexington Ave., New York City—The 33rd annual convention, St. Louis, October 15 to 17. The Jefferson hotel will be headquarters for the residential gas and industrial and commercial gas sections; the Mayfair and Lennox hotels for the operating section; and the Statler hotel for the accounting section.

THE 7th ALL-INDUSTRY REFRIGERATION AND AIR CONDITIONING EXPOSITION, to be held at Navy Pier, Chicago, November 5 to 8. The affair is sponsored by the Refrigeration Equipment Manufacturers Association, 1346 Connecticut Ave., Washington 6, D. C.

DIFFICULT PUMPING PROBLEMS?

Are you having problems handling high suction lifts? Troubles with volatile liquids or liquids containing abrasives? Difficulties handling sludges or liquids thick with solids?

Ask Marlow engineers for recommendations. Marlow specializes in manufacturing pumps which solve some of industry's most perplexing pumping problems. Marlow self-priming centrifugal and Marlow sludge pumps are exceptional in their capability to make formerly difficult tasks easy.



EXAMPLE — A large New York plant required pumps which would handle vaporous solvent efficiently — without the severe wear and high maintenance costs of other pumps. Marlow self-priming centrifugals provided the ideal answer.

Engineering Department,
Marlow Pumps, Ridgewood, N. J.

☐ Please send me literature on Marlow pumps.
☐ I attach description of a current pumping problem. Please make recommendations without obligation.

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MARLOW PUMPS

Leading Manufacturer of Self-Priming Centrifugal and Sludge Pumps

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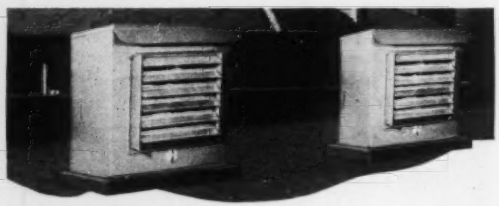
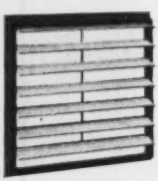
EFFECTIVE VENTILATION
with
Peerless Electric
PENTHOUSES AND FANS

Peerless Electric penthouses provide ideal ventilation for factories, laundries, stores, auditoriums and similar buildings.



Economical
Weathertight
AUTOMATIC SHUTTERS
Eight Sizes
12″ to 48″

Peerless Electric fans can be furnished for all sizes of these penthouses.



Automatic Shutters
Aluminum Louvers
Quiet
Counterbalanced

Ceiling Shutters in five square sizes
Wall Shutters in nine square sizes

Write for complete specifications on Peerless Electric penthouses, shutters and ventilating fans.

THE PEERLESS ELECTRIC COMPANY
Established 1893 • WARREN, OHIO

Peerless Electric
MOTORS • FANS • BLOWERS

RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 183. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Air Conditioning Equipment

HPAC 101—According to Remington Corp., Auburn, N. Y., there is a widespread need for standard and special high and low temperature air conditioning equipment, both in the armed forces and war production industries. The company has prepared a brochure briefly describing its services, products and facilities which are available for dealing with problems of military importance involving indoor climate control. The booklet describes mobile air cooling units, dehumidifiers, portable coolers, etc.

Air Diffusers

HPAC 102—A new 28 page brochure of Anemostat Corp. of America, 10 E. 39th S., New York 16, presents examples and ideas on ceiling architecture and shows how the four component parts controlling comfort—air diffusion, acoustics, lighting and color—can be coordinated to produce ceilings which are functionally correct and architecturally pleasing. In addition to discussing the four component parts, the booklet includes numerous sketches covering applications in offices, schools, theaters, churches, stores, industrial plants, hotels, airports, etc.

Bellows

HPAC 103—"Flexon" bellows, manufactured by Chicago Metal Hose Corp., 1316 S. Third Ave., Maywood, Ill., are available in a wide range of sizes and metals. They are manufactured of brass, stainless steel, bronze, monel and inconel in single and multiple ply construction and in various lengths. They are especially recommended for use in regulators, valves, steam traps, shaft seals, expansion connections and flexible connectors for misalignment. A new 16 page bulletin covers design and construction features, specifications, etc.

Cast Steels and Copper Alloys

HPAC 104—Lunkenheimer Co., Box 360-AA, Cincinnati 14, is offering two comprehensive brochures describing its cast steels and copper base alloys. The booklets have been prepared so that valve users may be cognizant of the inherent qualities of materials now being used in valve construction. The metallurgical information contained in these booklets deals with basic problems of metal soundness, porosity, welding, graphitization, creep strength, new alloys, code conformance, etc.

Combustion Control

HPAC 105—Automatic sequence combustion control, obtained by the use of a damper control offered by Cleveland Fuel Equipment Co., 7316 Associate Ave., Cleveland 9, is explained in a new 12 page bulletin. The damper control unit is said to contain all the elements necessary for safe and automatic operation (from the

control of overfire draft) and to provide proper draft and timing to assure efficient combustion. Applicable to oil, gas or stoker fired boilers, the unit is designed for use with the company's indicating gages and drive unit. Specifications for various models are given and recommendations are included as to application, installation and operation. Detailed information is also given on the company's new model SC-B unit for automatic regulation of steam pressure.

Cooling Towers

HPAC 106—A new four page bulletin describes cooling towers as designed and manufactured by Aqua-Therm, Inc., 723 Albany St., Dayton 1, Ohio. According to the bulletin, the distinctive feature of these towers is the use of ceramic saddle type "fill" material to provide increased surface area in relation to total volume. Technical data and a sample cooling tower problem are presented.

Data on Welding Fittings, Flanges

HPAC 107—Dimensions on its welding fittings and flanges that could otherwise be found only by searching through many catalog pages and tables have been condensed and reproduced by Taylor Forge & Pipe Works, Chicago 90, Ill., on two sides of an 8½ × 11 in. card. One side covers the "WeldELL" line of welding fittings and shows wall thicknesses and essential dimensions of all types ranging in size from ½ in. to 30 in. The other side covers forged steel flanges, with dimensions and bolting data given for pipe sizes from ½ in. through 24 in.

Dehumidification

HPAC 108—The Vol. 1, No. 2 issue of the house organ published by Kathabar Div., Surface Combustion Corp., Toledo 1, Ohio, features an article describing the use of its dehumidification equipment for reducing comfort conditioning loads and also includes another article describing how humidity control boosts gelatin capsule production. Information is also given on a system recently developed by the company for eliminating frost condensation on low temperature heat exchanger coils. The accumulation of condensed moisture is prevented by the continual spraying of an absorbent solution over the cold metal of the heat exchanger.

Diesel Engines

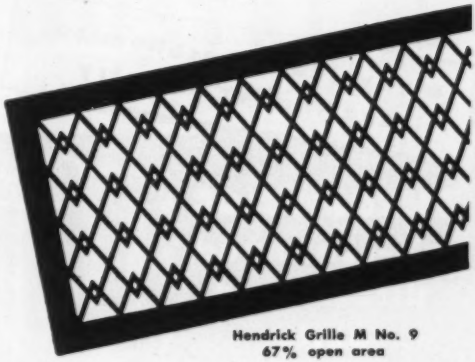
HPAC 109—An 18 page bulletin (S-500-B52A) on a new line of DR diesel engines has been released by Worthington Pump and Machinery Corp., Harrison, N. J. These four cycle, direct injection, totally enclosed engines are described and illustrated, and cut-away line drawings and specifications are included. Also described are the supercharged SOR engine, the DRGO dual-fuel diesel, and the SDRGO supercharged dual-fuel engine.

Direct Fired Air Heaters

HPAC 110—Bulletin 526 of Dravo Corp., Fifth & Liberty Aves., Pittsburgh 22, covers its "Counterflo" direct fired space heaters which are designed for gas or oil firing and have ratings from 400,000 to 2,000,000 Btu per hr. A feature of the bulletin is a comparison chart showing the steel requirements for installation of these heaters.

Draft Gages

HPAC 111—Bulletin 109, released by Ellison Draft Gage Co., 214 W. Kinzie St., Chicago 10, describes por-



Hendrick Grille M No. 9
67% open area

To harmonize with any decorative motif

there's a choice of over one hundred Standard Hendrick Grilles

Ornamental grilles, usually being the largest and most conspicuous article of hardware in a room, are a prominent factor in any decorative scheme. But from the wide range of Hendrick's distinctive designs it is easy to select a grille to meet any requirement.

Hendrick grilles can be supplied in a wide range of overall dimensions, bar sizes, number of perforations and size of perforations. Ample open areas ensure good air flow.

Made in accurate sizes, with clean-cut perforations and with no burrs or other imperfections, they are available in heavy-gauge aluminum, bronze, copper, Monel, steel and stainless steel.

They are easy to install, and always lie flat because of a special flattening operation in their manufacture.

Write for detailed information.

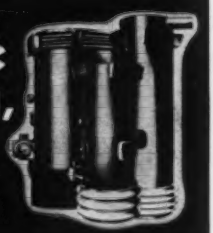
SEE OUR CATALOG IN SWEET'S

Perforated Metals
Perforated Metal Screens
Wedge-Slot Screens
Architectural Grilles
Mitco Open Steel Flooring,
Shur-Site Treads, Armorgrids

HENDRICK
Manufacturing Company
48 DUNDAFF STREET, CARBONDALE, PA.
Sales Offices in Principal Cities

a new idea in economical heating for industry

THERMOBLOC self-contained, direct-fired units

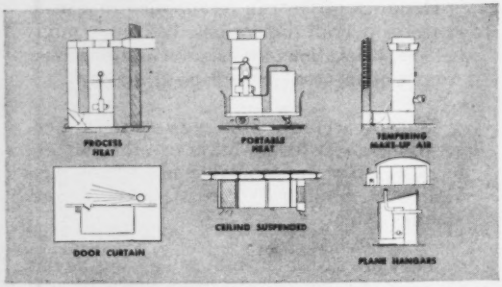


Efficient, controlled, low-cost heat!

Here's the answer to thousands of heating needs—the revolutionary new THERMOBLOC. Direct circulating heat from individual units keeps heated air moving in and around working areas. Has rugged, boiler-type construction. Easy to install, operates immediately on oil or gas. No complex piping, duct work or radiators. Units come complete or ready for simple assembly and prompt installation.

Installation costs as low as one-third, operating costs down to one-half of other types or methods. Perfect for large industrial plants, foundries, machine shops, bus terminals, warehouses and small or large commercial buildings, such as retail stores, skating rinks, gas stations, etc. Single units or combinations of any of the five sizes will meet any heating requirement.

Send for the data book. Contains tables and engineering data on heating constants, building materials, etc. Our engineers will help you on any heating problem. Mail the coupon today.



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PRAT-DANIEL CORPORATION
5-4 MEADOW STREET S. NORWALK, CONNECTICUT
Manufacturers of P-D Power Equipment

Gentlemen:

Please send me the THERMOBLOC Data Book.

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COMPANY _____

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table, stationary, and laboratory type inclined draft gages and accessories. Instructions for securing readings in conjunction with the company's Pitot tubes are given and tables of useful data are included. Also covered are vertical tube gages.

Expansion Joints

HPAC 112—The 1951 edition of Bulletin EJ-1912, covering expansion joints of Yarnall-Waring Co., Mermaid Lane, Philadelphia 18, is now available. Detailed information is given on all-steel "Gun-Pakt" joints and steel and bronze conventional "Glan-Pakt" joints. In addition to giving prices, weights, and dimensions, recommendations are given for determining the expansion of pipe lines and figuring anchors for pipe lines.

Flow Control Valves

HPAC 113—A new four page bulletin and a folder recently issued by H. A. Thrush & Co., Peru, Ind., illustrate and describe the company's complete line of air eliminating flow control valves. Both angle and vertical types are covered (either with or without an air tube) and data on dimensions, sizes, capacities, etc., are given.

Gear Couplings

HPAC 114—The gear couplings of John Waldron Corp., New Brunswick, N. J., are said to feature a one piece cover sleeve, a positive oil and dust seal, automatic lubrication, a relatively long lining-up surface, a cover sleeve bearing, and a relatively large bore. Various types of these torsionally stiff units are illustrated in a new six page bulletin.

Heating Control System

HPAC 115—A pocket size guide to help apartment, hotel and office building owners save money on annual fuel costs has been introduced by Minneapolis-Honeywell Regulator Co., 2604 Fourth Ave., S., Minneapolis 8. Designed in slide rule style, the guide shows, for example, how wind effect may double the heat loss of a building. It also illustrates the recommended length of burner operation in proportion to outside temperature. The purpose of the guide is to demonstrate how the company's "Weatherstat" control system saves fuel.

Heating Specialties

HPAC 116—Maid-O'-Mist, Inc., 3217 N. Pulaski Rd., Chicago 41, has issued an eight page general catalog covering all company products and giving sizes, dimensions, capacities, etc. In addition, the catalog has been separated into single sheet, two page pieces as follows: Form No. 701-A—radiator humidifiers; 701-B—warm air humidifiers and water level controls; 703—"Auto-Vent" air eliminators and balancing valve adapter units; and 705—steam boiler automatic feeders and low water cut-offs.

Hydraulic Filter

HPAC 117—A recently issued catalog of Dollinger Corp., 11 Centre Pk., Rochester 3, N. Y., covers the new "Staynew" hydraulic filter designed for use where dirty liquids are collected and recirculated. The filter is recommended for application on machine tools, conveyors, plastic molding machines, hydraulic presses and many

Moore INDUSTRIAL

AXIAL FLOW PRESSURE BLOWERS

(Vaneaxial)

THE MOTOR IS IN THE HUB — IT'S DIRECT DRIVE

Moore Class 2000 pressure blowers are used in duct systems with filters and coils for industrial ventilation and other large industrial air moving applications. They are manufactured of steel, monel, or stainless for corrosive atmospheres — custom assembled without extra cost for maximum efficiency at volume and pressure desired. Moore blowers are the answers to tough ventilating problems and are particularly adaptable to cooling tower applications. You'll be pleased with their performance and assured of repeat orders and highest customer recommendation when you install Moores exclusively.

Please write us today for specifications, etc.

36" PRESSURE BLOWER Class 2000

Blower Diameters—
(16" hub)
32", 36", 42", 48", 54", 60".
(24" hub)
48", 54", 60" 72", 84", 96".

THE Moore COMPANY 810 S. MISSOURI, MARCELINE, MO.

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weil "TVC" CONDENSATE

FOR LOW PRESSURE SYSTEMS

(WRITE FOR BULLETIN TVC-300)

LOW RETURN CONNECTION

CAST IRON RECEIVER

WATERLINE EXTREMELY LOW

Provides Freedom of Layout
Permits Overhead Lines
Capacities—500 to 10,000 sq. ft. E.D.R.

NOW IN YOUR JOBBER'S STOCK

Fig. 302

Also ask about

NRG Series

for underground installations — takes the low returns and pumps them back to boiler. Only limited space required.

OTHER TYPES

TYPE R

Hot and chilled water circulating
Ball bearing—once a year lubrication
Capacity—10 to 750 GPM
(write for Bulletin R5500)

TR HORIZONTAL

Low and high pressure systems
Ball bearing—heavy duty
Capacities to 100,000 sq. ft. E.D.R.
Pressures to 125 P.S.I.

weil PUMP COMPANY

1523 NORTH FREMONT ST.
CHICAGO 22, ILLINOIS

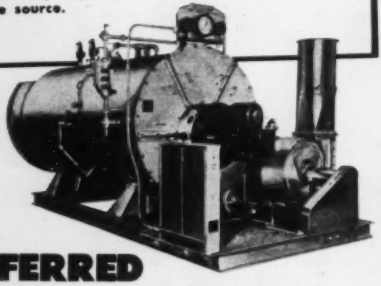
ONLY PREFERRED Offers Lowest Installation Costs

That's right! To install a Preferred Horizontal Rotary Oil Burner costs less than any other industrial oil burner. Exclusive and patented features cut time and labor needed for wiring, brickwork and piping. For example, all basic burner components are completely wired to the terminal junction box. Preferred has been able to lower installation costs because of their years of experience as a dealer, installer and distributor of oil burners. And they have put this practical experience to work for you.

Originally designed to meet the exacting requirements of the Preferred Unit Steam Generator, its fully automatic operation with residual fuels proved so successful that it has won wide acceptance for conversion applications.

It is available with associated Preferred products such as enclosed, pre-wired, union approved panels as well as pump and heater sets where applicable.

At Preferred you get all major job requirements from a single source.



PREFERRED Unit Steam Generator

The Preferred Unit Steam Generator is a custom-built boiler designed to maintain its guaranteed efficiency for a quarter of a century with a minimum of maintenance. It is the result of 28 years of combustion experience combined with the latest technical advances in pressure vessel design. That is why the Preferred unit offers the lowest installation cost, greatest economy and longest life of any steam generator.

Write for Burner Bulletin 175, Generator Bulletin 1000 and material cost estimates on your application. PR-201

PREFERRED UTILITIES MANUFACTURING CORPORATION
1860 BROADWAY, NEW YORK 23, N. Y.

other types of cutting tools and hydraulically operated machines. In most cases the filtering medium is 100 mesh stainless steel wire and the filter insert is of radial fin construction. Media of other metals are available.

Industrial Controls

HPAC 118—A new 60 page catalog, prepared by Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, covers over 100 different models of nonindicating electric, electronic, and pneumatic controllers. A number of additions to the previous line are shown. Among them are electric, electronic, and pneumatic insertion type temperature controllers, magnetic starters and contactors, heavy-duty pneumatic positioning motors, pneumatic automatic reset relays, and both pneumatic and electric step controllers.

Insulation Materials, Gaskets, Packings

HPAC 119—A condensed bulletin of Union Asbestos & Rubber Co., 332 S. Michigan Ave., Chicago 4, provides only sufficient data, brief descriptions and broad classifications to facilitate the inquiry of procurement agencies and others engaged in the defense mobilization program. Products briefly outlined for use in aircraft, ships, armored vehicles, trucks, railroad equipment, and industrial plants include acoustical materials, insulating felts, gaskets, thermal insulation, and packings.

Liquid Level Controls

HPAC 120—"Autocon Tanktrols" are pressure operated pump controls designed for use with elevated tank systems. They are installed at the pump site and automatically operate pumps by means of pressure changes at predetermined high or low tank levels. One bellows is used for high level control; the other is for low level control. Operation is described and illustrated and design and contruction features are covered in Bulletin No. 1100 of Automatic Control Co., St. Paul 4, Minn.

Metal Fastener

HPAC 121—A new small metal fastening device is being marketed by American Shower Door Co., 1028 La Brea, Los Angeles. Known as the "Thumweld", it is designed primarily as a permanent fastener where rapid assembly or disassembly is important and for parts that are occasionally removed for service or inspection, such as access plates, metal housings, panels, etc. Detailed information is given in a new folder.

Modulating Controls

HPAC 122—Diagrams showing typical applications of its modulating controls in connection with unit heaters, radiators, and zone controls, together with other heating, ventilating, and cooling equipment, are featured in a bulletin released by Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Knoxville 4, Tenn. Over 20 regulators are briefly described and illustrated and a discussion of compensated regulators for heating and ventilating systems is included.

Nonreturn Valve

HPAC 123—The cushioned single-acting nonreturn valve of Golden-Anderson Valve Specialty Co., 2104 Keenan Bldg., Pittsburgh 22, is described and illustrated in Bulletin S-2. Three different yoke assemblies on the

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elbow, angle and globe bodies are featured in detailed drawings, with a complete list of parts. Adaptability, testing, construction, installation, sequence of operation, servicing and specifications are fully described. Tables give general dimensions, shipping weights, and lists of materials.

Oil Burners

HPAC 124—A new condensed 16 page catalog in color has been issued by Ray Oil Burner Co., 401-499 Bernal Ave., San Francisco 12. The booklet gives a complete listing, with illustrations, of the company's products which include fully automatic horizontal rotary type burners, steam turbine driven burners, combination gas-oil burners, semi-automatic and pressure atomizing burners. The booklet also features a selector chart and lists specifications.

Pipe Line Filters

HPAC 125—"Staynew" pipe line filters for air and other gases of Dollinger Corp., 11 Centre Park, Rochester 3, N. Y., are designed for the removal of dirt and pipe scale from compressed air lines, to filter corrosive gases and air or gas at high pressures or temperatures, to remove condensed oil and water vapor from compressed air lines, and to protect vacuum pumps by the removal of foreign matter. Tabulated specifications and brief descriptions of the various models are given in a new eight page bulletin.

Propeller Fans

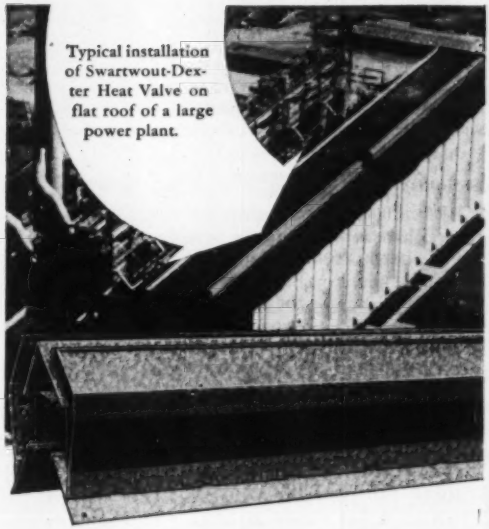
HPAC 126—Bulletin 3146 of Herman Nelson Div., American Air Filter Co. Inc., Moline, Ill., deals with propeller fans designed for institutional, industrial, and commercial use. Six basic models of fans are described and design and construction features are covered. Many typical installations are illustrated.

Refrigerants

HPAC 127—"Freon" refrigerants and propellents — their development, manufacture, properties and uses — is the subject of a new 40 page catalog issued by E. I. du Pont de Nemours & Co., (Inc.), Kinetic Chemicals Div., Wilmington 98, Del. This profusely illustrated booklet explains why these refrigerants were developed, describes their commercial production, and provides information on their general characteristics. Numerous photographs are used to illustrate the wide range of applications in comfort air conditioning, the transportation and marine industries, in institutions, the preservation of foods and specialized industrial operations.

Refrigeration Accumulator

HPAC 128—The "Icy-Flo" accumulator described in bulletin 108 of McQuay, Inc., 1600 Broadway, N. E., Minneapolis 13, is designed to store cooling capacity for air conditioning so as to obtain high cooling capacity with a relatively low capacity condensing unit. It is especially recommended for installation in churches, auditoriums, meeting rooms, cafeterias, etc., where heavy loads of short duration are encountered. The bulletin includes a compressor-accumulator balance diagram, tabulated data on discharge rates, water flow, and general specifications. Various hook-ups are shown and example selection problems are given.



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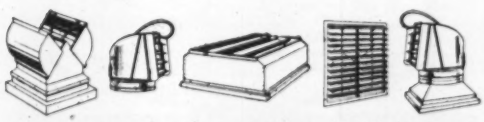

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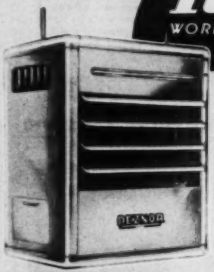

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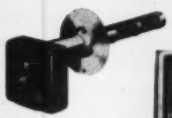

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Relief and Safety Valves

HPAC 129—Marine & Industrial Products Co., 3731-35 Filbert St., Philadelphia 4, has prepared a two-color chart for determining the steam capacity required of its safety valves to provide adequate protection in the event of pressure reducing valve failure. Reducing valve sizes shown on the chart range from ½ to 6 in.

Stainless Steel Tubing

HPAC 130—Current restrictions on the use of nickel in steel have forced engineers to seriously investigate the use of straight chromium stainless grades. To assist in solving the problem, Babcock & Wilcox Tube Co., Beaver Falls, Pa., has published a new four-page bulletin (TDC 140) outlining the physical and mechanical characteristics of three nonhardening straight chromium stainless tubing steels. Included are data on analyses, creep strength, properties at room and elevated temperatures, corrosion and oxidation resistance, forging, forming, machining, welding and heat treatment.

Steam Traps

HPAC 131—V. D. Anderson Co., 1949 W. 96th St., Cleveland 2, has revised its 36 page catalog on solving steam trap problems. It contains revised specifications and capacities of the company's complete line of "Super-Silvertop" steam traps, float traps, air release valves, and pipe line strainers. Information is given on how to calculate condensation loads and how to select traps for all classes of equipment. Recommendations are given for installation and servicing.

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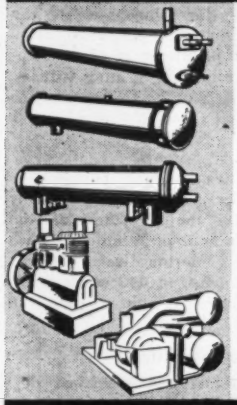

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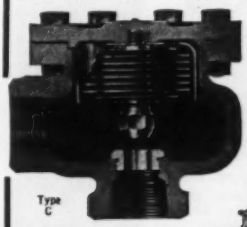
5 TYPES FOR EVERY APPLICATION, process, heat, power. Sizes, ¼" to 2"; press. to 225 lbs.



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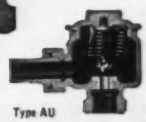

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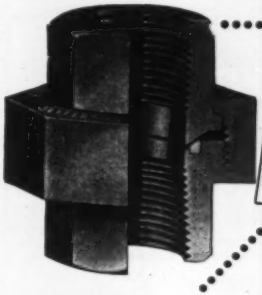

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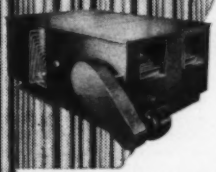

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Built in sections - Vertical or horizontal mounting. Various combinations and arrangements of discharge and by-pass damper.

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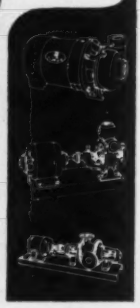

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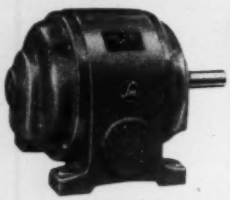

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Steel Pipe

HPAC 132—Spang-Chalfant Div., National Supply Co., Grant Bldg., Pittsburgh 30, has prepared a new 32 page bulletin (No. 370) on its CW steel pipe. The booklet covers black and galvanized pipe in standard sizes from $\frac{1}{8}$ in. to 4 in., with tables of dimensions, weights, test pressures, threading data, and bundling schedules. Profusely illustrated, it presents a picture story of the steps of manufacture from skelp through the heating furnace, the continuous welding process, and numerous finishing operations by which the company's steel pipe is made.

Stud Welding

HPAC 133—Detailed specifications and performance characteristics of two "Nelwelder" power units specifically designed to improve and extend the advantages of stud welding are described in a new four page bulletin issued by Nelson Stud Welding Div., Morton Gregory Corp., Lorain, Ohio. One operates on 220 or 440 volt a-c current; the other is a battery operated unit utilizing 110 volt a-c current for charging.

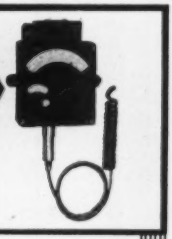
Thermal and Acoustical Duct Insulation

HPAC 134—"Ultralite" thermal and acoustical duct insulations are briefly described in a folder released by Gustin-Bacon Mfg. Co., 1412 W. 12th St., Kansas City, Mo. Advantages are outlined and an actual sample of the material is included.

Unit Heaters

HPAC 135—Bulletin No. 760 on downflow unit heaters and Bulletin No. 322 on horizontal heaters of McQuay,

NEW TYPE CI



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The new Type CI Adjustable Indicating Thermostat is a precise temperature control for gas, liquid, and metal-to-metal applications, such as ovens, hot plate presses, water baths, incubators, proofing cabinets and cold cabinets. It is most useful on units where periodic checks of temperature are required, advisable, or will prove time-saving. The new Type CI is simply and ruggedly built, employing the highly sensitive response action of a solidly liquid-filled bulb and bellows assembly to a snap-acting switch and indicating pointer. The thermostat is adjustable over its entire range by a knurled thumbscrew on the front of the case.

SPECIFICATIONS:

Case 5½ x 5½ x 1¾", Wt. 3 lbs. Standard ranges 50° – 350°F and 50° – 600°F, special ranges may be had between –120°F and +600°F. Standard differentials ½°F in circulating liquid, 2°F in air. Switch ratings 10 amp 125 V AC and 5 amp 250 V AC. Write for new bulletin No. 4816T which gives full details.

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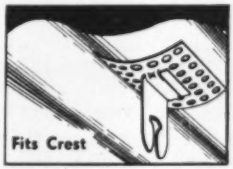
Stic-Klips with CURVED BASES for Insulation Installation on Corrugated Surfaces of Penthouses and Metal Buildings.



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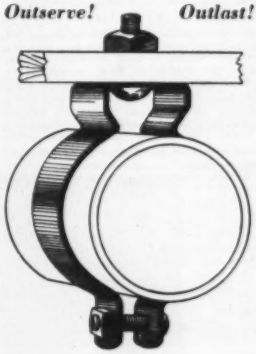

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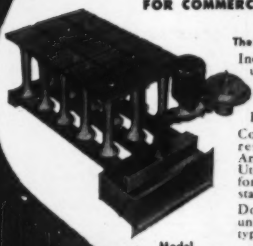

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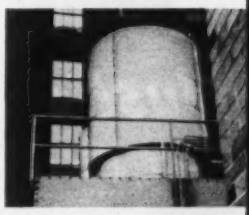

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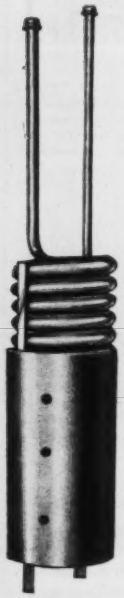

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No. 5 and Bunker "C" oils flow more freely at high temperatures. The Rempe "Hot Spot" preheats such liquids in bulk storage. Preheating is assured by exclusive flow accumulator — liquids flow over heating coils before entering the suction.

Illustration below shows how this preheater is installed in a bulk storage tank. Heating and suction pipes pass through the manhole cover.

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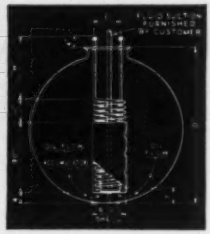

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Inc., 1600 Broadway, N. E., Minneapolis 13, are condensed catalogs which cover basic steam and hot water ratings, air deliveries, steam conversion factors, and specifications.

Valve Sizing Charts

HPAC 136—A steam valve sizing chart covering the range from 1 to 1,000,000 lb per hr and a butterfly valve sizing chart covering the range of 15 to 10,000 gpm have been published by Fischer & Porter Co., Hatboro, Pa.

Water Treatment for Radiant Heating

HPAC 137—The Vol. 20, No. 2 issue of the house organ published by W. H. & L. D. Betz, Gillingham & Worth Sts., Philadelphia 24, features an article on water problems in radiant heating systems. After briefly describing the types of radiant heating systems commonly used, the article points out that scale formation is rarely a problem in these systems but stresses the fact that corrosion from dissolved oxygen will often occur. It is stated that the most effective control of corrosion in radiant heating systems can be obtained by the use of a chemical inhibitor, such as one of the chromates.

Zeolite Softener

HPAC 138—Cochrane Corp., 3131 N. 17th St., Philadelphia 32, has prepared Publication 4520 on its sodium zeolite water softeners. Included are an explanation of the softening process, definitions of descriptive terms used, data for laying out a zeolite water softening plant, factors governing the sizing of equipment, and a description of materials used. The bulletin features a description of the company's single control valve.

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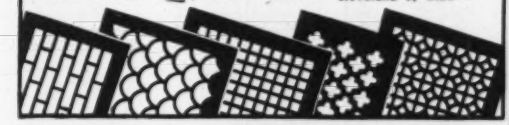

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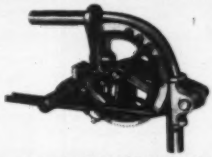

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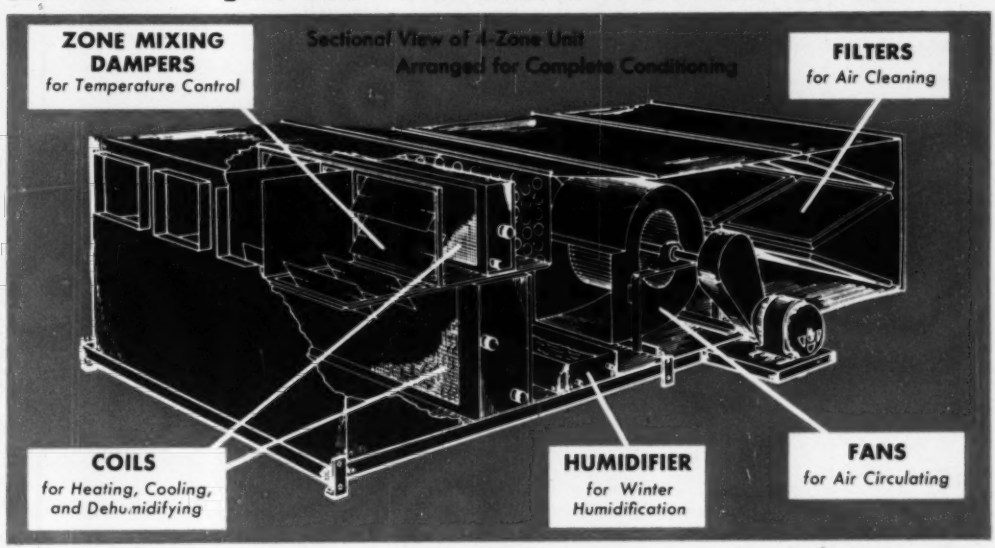
Blow-Thru MULTITHERMS



for ZONE CONTROL *Air Conditioning*

Different Temperatures and Humidities at the SAME Time with ONE Unit

One Clarage Blow-Thru Multitherm can be used to air condition various parts of your building exactly as your requirements warrant.

ZONE CONTROL compensates for the difference in solar radiation on different parts of a building during different times of the day. It also takes into account variations of exposure, wind velocity, construction, and different internal heat loads.

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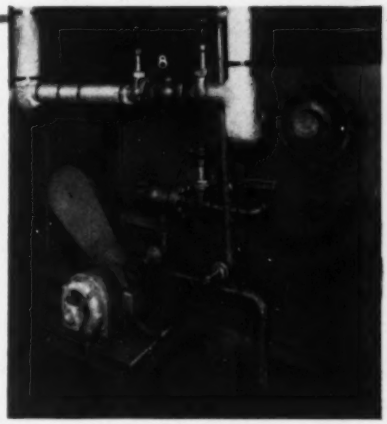


This 3-zone Blow-Thru Multitherm unit air conditions the 2-story office building of the Northern Indiana Brass Co., Elkhart, Indiana. Installation made in December, 1940.

CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

NEW BULLETIN 1310 gives descriptive details, specifications, capacities, and dimensions. Send for your free copy today.

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

Announcing —

a full line of McDONNELL Btu.-Rated Safety Relief Valves for Domestic Hot Water Tanks and Heaters

One of the worthiest jobs for every heating man is to put every domestic hot water heater and tank on a *SAFE* operating basis . . . and it also happens to be a highly profitable job. The best way to do this at a moderate cost is illustrated and explained here . . . but first consider the background of this development:

As every heating man knows, every hot water storage tank down to the smallest domestic heater is a pressure vessel designed for some predetermined working pressure that should *never* be exceeded. This too-often neglected fact was fully recognized several years ago by an engineering committee of the National Bureau of Casualty & Surety Underwriters who did a large amount of research work on the protection of heaters and tanks.

Their work, later confirmed by an All-industry group, showed that keeping tank pressure within safe limits is fully accomplished when the pressure relief valve has *sufficient capacity to dissipate the maximum heat output of the tank.* This finding is covered by the recommended testing procedure outlined in the A.S.M.E. boiler code. In substance, the A.S.M.E. code recommends that *every* hot water heater shall be equipped with a relief valve having tested, rated, and certified capacity to dissipate the gross heat output of the heater or tank. That's putting it down strong . . . as well it should be.

The McDonnell Safety Relief Valves announced here meet this recommendation to the letter. They are tested and certified as provided in the code and carry on their nameplates the official A.S.M.E. symbol of compliance along with the certified ratings in Btu.'s per hour. The accompanying table covers opening pressures and certified ratings. Note that the final numbers show the opening pressures (3345 opens at 45 lbs., 3375 opens at 75 lbs., and so on). This means that you can equip any tank or heater in your territory with a valve matched to its Btu. output, thus giving the owner protection from overpressure.

Cost is low —Every domestic tank and heater needs this protection, but until this series of valves was developed the added cost of Btu.-rated valves has been a barrier to their universal use. Now that barrier is completely broken down by the development of a valve of such ingenious simplicity that it costs little if any more than valves of unrated capacity and questionable dependability. Note the facts about the design and operation of these valves.

The cut shows actual size of the No. 33 series for domestic hot water service. Every valve is tested, certified and A.S.M.E. labeled. Valve needle is stainless steel, hardened and precision ground to polished finish. Seat is also stainless, machined to exacting tolerance. Testing lever is remarkably easy to lift and functions independently of valve stem—an exclusive feature. Note exclusive hydra-lift principle, explained below, which distinguishes it from all other valves. Sizes and ratings are:

Valve No.	Opening Pressure	Certified Capacity in Btu. per hr.
3345	45 lbs.	321,300
3375	75 lbs.	308,700
33100	100 lbs.	423,900
33125	125 lbs.	513,900
33150	150 lbs.	605,700

Inlet size of all valves, 3/4"; outlet size, 1".

Yours Soldier Speaks Thanks

McDONNELL & MILLER, INC.
3300 N. Spaulding Avenue • Chicago 18, Illinois

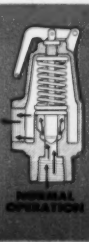
Doing One Thing Well

McDONNELL Safety Relief Valves

Ask for catalog sheet giving complete details

The nameplate tells the whole story—

Each McDonnell Safety Relief Valve has this plate showing capacity in Btu. per hour as certified by National Board; also A.S.M.E. Code Symbols, size, and opening pressures. You can be sure it is properly matched to the tank or heater.



Ideal Operating Characteristics

When merely discharging excess water caused by normal expansion, a high discharge rate is not desirable in a relief valve. But when an emergency arises it should open wide and go to work. The No. 33 series meets both of these conditions. Diagram at left shows normal operation. When pressure rises to operating setting valve needle lifts just enough to take care of thermal expansion. Diagram at right shows emergency operation. When temperature rises into emergency range, increased velocity acts on "hydra-lift" disc, snapping valve wide open to discharge a full capacity.